IN THE NAME OF ALLAH

Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The 38th Khwarizmi International Award

The 26th Khwarizmi Youth Award

February 2025

بسم الله الرحمن الرحيم

يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ
وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ
وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ

In the Name of Allah
"Allah will raise up in ranks those who believed among you and those who have been given knowledge. Allah is aware of what you do."

Holy Qur`an, Surah al-Mojadele, Ayah 11


جشنواره بین المللی خوارزمی
سی و هشتمین جشنواره بین المللی خوارزمی
وزارت علوم، تحقیقات و فناوری
سازمان پژوهش‌های علمی و صنعتی ایران
اسفند ۱۴۰۳

Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

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Minister's Foreword

In the Name of ALLAH

The Khwarizmi International Award, as a beacon of excellence of the Islamic Revolution of Iran with four decades of distinguished experience, has become one of the most valuable social assets of the country in the realm of scientific and technological development. This reputable scientific event plays a unique role in advancing the country's scientific and innovative goals by bringing together the most prominent researchers and technologists across various fields of science and technology.

The Khwarizmi Awards has continually maintained its dynamism and effectiveness by creating innovative mechanisms and addressing both national and international needs. This prestigious event stands as a premier platform for recognizing and showcasing the foremost scientific and technological accomplishments, while also supporting the achievements of the Iranian scientists and innovators. Iran's strong presence in scientific, regional and global developments, its pursuit of economic independence, addressing social needs, and the focus on strengthening and developing knowledge-based enterprises are all strategic priorities for the country's science and technology system.

In this context, recognizing the valuable efforts of Iranian intellectuals and scholars, along with providing targeted support for researchers, innovators, and technologists especially in the commercialization of scientific findings is essential for the sustainable development of the country. The innovative ideas and applied research presented at this Award drive the commercialization of knowledge-based products, foster productive employment, and generate significant added value, paving the way for a bright future in the country's scientific landscape.

I would like to sincerely express my gratitude to the esteemed President of the Iranian Research Organization for Science and Technology, the award jury, the members of the scientific committees, the dedicated staff of the Permanent Secretariat of the Khwarizmi Awards, and all colleagues in various sections of the Ministry of Science, Research, and Technology. Their invaluable efforts have made the continuous organization of this prestigious and dynamic event possible over the past thirty-eight years.

I hope that the Khwarizmi International Award will continue to be a catalyst for the scientific and technological advancement of the country, serving as a platform for expanding international collaborations. May we witness the ever-greater brilliance of Iranian scientists and technologists on both national and international stages.

Professor Hossein SIMAEI
Minister of Science, Research and Technology

Chairman's Foreword

In the Name of ALLAH

The International Khwarizmi Award, honored with the name of one of the most renowned scientific figures in Iran and the world, has taken firm steps toward identifying and introducing innovative, fundamental, applied and research and development projects to the scientific community and industry. This prestigious event, beyond being a scientific gathering, has provided a platform for expanding scientific and technological interactions at both national and international levels, contributing to the strengthening of Iran's scientific and cultural diplomacy.

Every year, the Khwarizmi Award hosts distinguished iranian and international intellectuals and technologists, creating a dynamic environment for the exchange of thoughts, ideas, and experiences. This Award presents a deserving image of Iran and its significant scientific and technological achievements to the international scientific community. With special emphasis on scientific innovations and new technologies, the Award plays a pivotal role in promoting knowledge and technology in Iran and across the globe, proudly representing the scientific and technological advancement of the country.

The Iranian Research Organization for Science and Technology, as the organizer of this international scientific event, has always sought to leverage the dynamism and potential of this Award to identify and introduce the valuable human and scientific assets of the country and safeguard the values and achievements resulting from this scientific competition.

This year's Award has attracted considerable interest from scholars and technologists domestically and from over thirty foreign countries, showcasing dozens of valuable projects and evaluating the latest scientific achievements and advanced technologies. Creating a competitive environment for the precise evaluation of projects and subject-specific discussions in the realm of emerging technologies provides a valuable opportunity to present effective and sustainable solutions to the challenges facing humanity and to make steadfast strides in addressing the scientific and technical issues of the world. Additionally, establishing effective connections and multilateral collaborations not only enhances the level of scientific and technical knowledge and capabilities but can also lead to positive and lasting impacts on national, regional, and global development.

In this context, I would like to sincerely thank the Ministry of Science, Research and Technology, my colleagues at the Iranian Research Organization for Science and Technology, the Permanent Secretariat of the Khwarizmi Awards, the jury members, the members of scientific committees, and national and international sponsors.

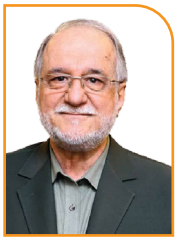
Professor Alireza ASHORI
Chairman
The 38th Khwarizmi International Award

Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Laureates of the 38th Khwarizmi International Award

Outstanding Researcher
Scientific Committee: Mechanical Engineering

Outstanding Researcher for Lasting Role in the Development of Science and Technology



Researcher: Professor Saeed Sohrabpour

Country: I.R. Iran

Field: Mechanical Engineering

Scientific Affiliation: Sharif University of Technology

Biography and Achievements:

Professor Saeed Sohrabpour was born in 1943 in Tehran. He completed his secondary education at Alborz High School in Tehran and then pursued a degree in Mechanical Engineering at the University of Tehran. In 1965, after graduating with a top rank from the Faculty of Engineering at the University of Tehran, he won a government scholarship to continue his studies at the University of California, Berkeley. He earned his Master's and Ph.D. degrees in Mechanical Engineering from this university in 1971. During his studies in the United States, Professor Sohrabpour became acquainted with Martyr Dr. Mostafa Chamran and participated in his weekly cultural and political gatherings. This interaction had a profound impact on his perspective and worldview, as he and his wife later expressed, saying, "Dr. Chamran changed our worldview and influenced our outlook on various issues, and we feel indebted to him." He returned to Iran in 1971 and engaged in teaching and scientific activities at Shiraz University. After eighteen years of service at this university, he moved to Tehran in 1989 and continued his scientific endeavors at Sharif University of Technology. Professor Sohrabpour was appointed as the President of Sharif University of Technology by the Minister of Science, Research and Technology in 1997, and his presidency continued until 2010. Many experts believe that under his leadership, the university achieved stability and consolidation, which paved the way for its expansion in scientific, cultural, educational, and physical infrastructure dimensions, becoming a benchmark in higher education in the country. Professor Sohrabpour has authored over seventy articles in reputable domestic and international scientific journals. Professor Sohrabpour has also mentored numerous Master's and Ph.D. theses, significantly impacting the academic and educational advancement of new generations.

Administrative Background and Honors

- Head of Imam Khomeini International University (1995-1997)
- President of Sharif University of Technology (1997-2010)
- National Outstanding Professor, Ministry of Science, Research, and Technology (2011)
- Jury Member of the Khwarizmi International Award (2007-2015)
- Deputy President of the National Elite Foundation (2006-2016)
- Permanent Member of the Academy of Sciences of the Islamic Republic of Iran
- Member of the National Academy of Engineering of the USA
- One of the founders of the Pardis Technology Park

The Second Place
Innovation

Scientific Committee: Electrical and Computer Engineering

Research Work Title

Design and Development of a Real-Time Ultrasound-Guided Electrical Breast Mass Detection System

Researcher: Dr.Mohammad Abdolahad

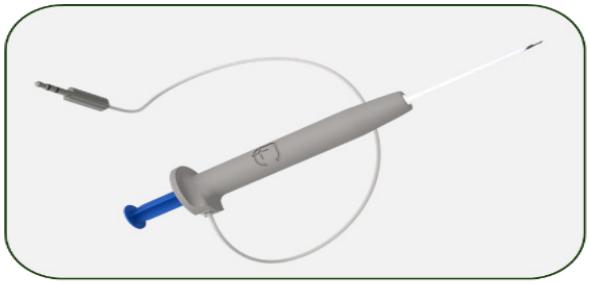
Collaborator: Dr.Reihaneh Mahdavi

Organization: Nano- Bio-Electronics Lab, Faculty of Engineering of University of Tehran

Collaborating Organizations: Vira Biotechnology Co., Hospitech Co.

Abstract:

Borderline breast diseases (BBD) refer to a group of breast lesions that can lead to diagnostic uncertainty in sampling. These masses may be associated with malignant tumors, making accurate diagnosis of them highly important. In pathological guidelines, it is strongly recommended that these masses be removed from the body. However, in ultrasound evaluation, they may be overlooked as BI-RADS 3, and if more sensitive equipment is not available, biopsies may not be recommended for them. This situation can lead to a delayed diagnosis of potentially dangerous and premalignant masses. These masses are primarily observed in younger patients with dense glandular tissue, which makes mammographic evaluations challenging and is associated with a high rate of false-negative results. Early diagnosis of these masses is particularly important for patients with a family history of breast cancer or for women who plan to become pregnant. The Impedimetric Tumor Detection System (ITDS) is designed based on electrical impedance spectroscopy and can distinguish benign tissues from premalignant or malignant ones. The electrical impedance of biological tissues under alternating electrical stimulation is related to their composition and structure. The system is capable of detecting BBD during breast radiology and is currently awaiting final approval, following testing on 20 animal tumor biopsies and 313 in vitro human biopsies. The sensitivity, specificity, and accuracy of this device have been measured at 95.6%, 89.1%, and 93.5%, respectively.



The Second Place
Basic Research
Scientific Committee: Chemical Technologies

Research Work Title

Molecular Fold Topology

Researcher: Professor Alireza Mashaghi Tabari

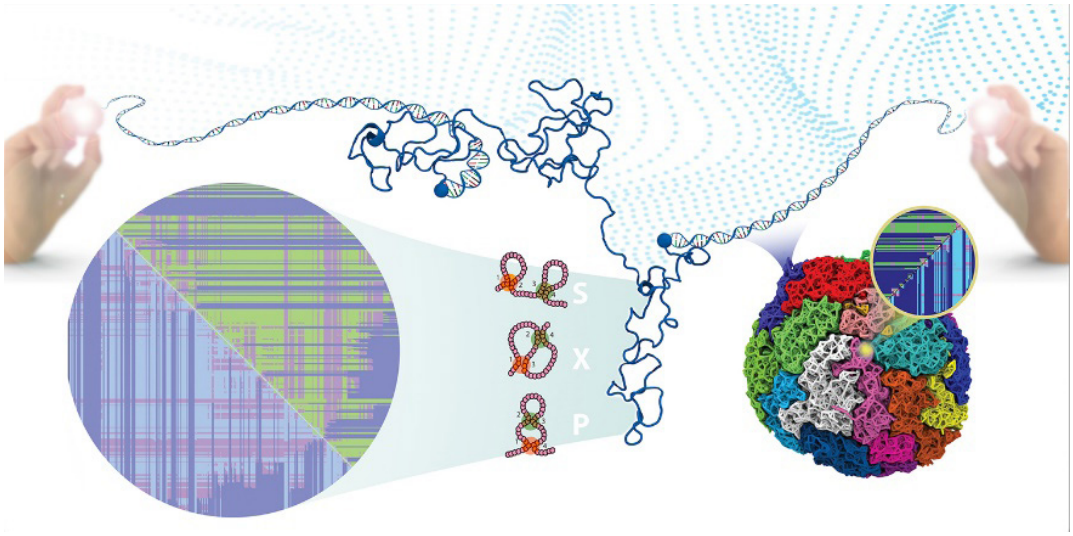
Country of Residence: Netherlands

Scientific Affiliation: Leiden University, Netherlands

Abstract:

Folding of biopolymers, such as proteins and nucleic acids, is crucial for cellular function, with misfolding linked to diseases like neurodegeneration, muscular dystrophy, and cancer. Alireza Mashaghi pioneered the use of single molecule mechanical manipulation for protein fold analysis, advancing our understanding of these processes. Utilizing optical tweezers, the Mashaghi group was the first to observe the folding and unfolding of a protein in the cytosol, the inner environment of a cell. Importantly, Mashaghi invented "Circuit Topology", a unique fold analysis framework that provides a comprehensive classification of biomolecular structures and chain entanglements, including proteins, cellular genome, and biomolecular condensates. This dual approach offers unprecedented insights into biomolecular folding mechanisms in health and disease, providing a robust platform for future biomedical research and therapeutic developments. Finally, the circuit topology approach inspired new developments in mathematics and is broadly applicable to studying the physics of polymers and engineering new polymeric materials.

Professor Alireza Mashaghi is an internationally recognized physician-scientist who has been affiliated with various academic institutions including Leiden University, Harvard University, Delft University of Technology, ETH Zurich, and Max Planck Institute for Multidisciplinary Sciences. He has served as an advisor for various agencies, including Swiss National Science Foundation, German Research Foundation (DFG), UK Research and Innovation (UKRI), and European Science Foundation (ESF). He also serves on editorial boards of journals including Nano Research.



The Third Place
Basic Research
Scientific Committee: Chemical Technologies

Research Work Title

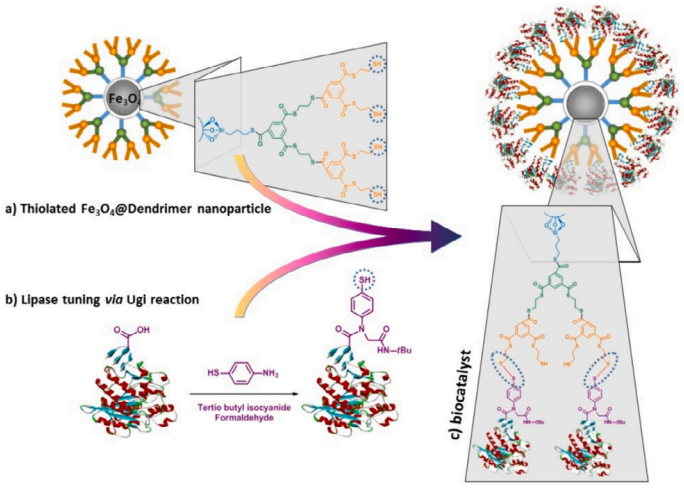
Synthesis of Dendritic Materials and Investigation of their Catalytic Capability

Researcher: Dr. Majid Moghadam

Organization: University of Isfahan

Abstract:

Dendrimers are a class of three-dimensional polymers at the nanoscale, characterized by their compact spherical structures in solution. These large, uniform, and equally sized molecules possess a well-defined branched three-dimensional architecture, comprising three main components: the core, branches, and terminal groups. Typically, dendrimers are synthesized through repetitive processes, with each cycle resulting in the formation of an additional layer of branches, known as a generation. When dendrimers are supported on insoluble inorganic surfaces or organic polymers, they are referred to as dendritic materials or immobilized dendrimers. In this project, we focus on synthetising dendritic materials, a class of novel substances that have gained significant attention due to their diverse applications in recent years. These materials serve as hosts for catalysts, including molybdenum and ruthenium complexes, as well as nanoparticles of palladium, copper, gold, bismuth, and ruthenium. They play a crucial role in catalysing various reactions, such as the oxidation of alcohols and alkenes, carbon-carbon coupling reactions, the synthesis of triazoles, and other organic transformations. Additionally, these materials have been employed as supports for the immobilization of various enzymes, including lipase for biodiesel production from edible oils, as well as xylanase, glucose oxidase, and glucoamylase for the direct conversion of glucose to gluconic acid. Due to their unique properties, dendritic materials are also utilized as nanocarriers for the smart delivery of anticancer drugs, such as 6-mercaptopurine, doxorubicin, and methotrexate, which are used in the treatment of cancerous tumors in mice, yielding promising results.



The Third Place
Applied Research
Scientific Committee: Chemical Technologies

Research Work Title

Production and Development of a $^{68}Ge/^{68}Ga$ Generator with Enhanced Activity of Gallium-68 based on SnO_2/TiO_2 Adsorbent for Application in Nuclear Medicine Centers

Researcher: Dr.Mahdi Gholamhosseini Nazari

Collaborators: Mohammad Reza Davarpanah, Khosro Aardaneh, Mohammad Yarmohammadi, Meghdad Gilani, Miad Hashemizadeh, Hojjat Masoumi, Ali Rahiminezhad

Organization: Pars Isotope Company

Abstract:

Gallium-68, with a half-life of 68 minutes, is obtained from a generator containing Germanium-68, which has a half-life of 271 days (68Ge/68Ga generator). This radionuclide element and its generator have received significant attention over the past decade, and are widely used for diagnostic purposes in nuclear medicine. For more than half a century, Technetium-99 (with a half-life of 6 hours), derived from the 99Tc/99Mo generator (with a half-life of 66 hours), has been the main radioisotope used in SPECT imaging for diagnostic purposes. Given the various advantages such as the shorter half-life of Gallium-68 (compared to Technetium-99m) and the longer half-life of the 68Ge/68Ga generator (compared to the 99Tc/ 99Mo generator), along with its application in PET scan, the radiopharmaceutical industry worldwide has focused on the use of Gallium-68 and the development of the 68Ge/68Ga generator. Investigation of scientific documents shows that, for various scientific and economic reasons, producing generators with the highest possible output of Gallium-68 is one of the main and valuable goals of commercial companies and scientific communities. In this project, by synthesizing a SnO2-TiO2 matrix resin with a unique formula, a 68Ge/68Ga generator was designed and produced for the first time in Iran. Furthermore, modifications of this generator led to enhanced capacity for loading Germanium and, consequently, improved performance of the 68Ge/68Ga generator (named Pars-GalluGen generator). This generator has an output activity of over 70 mCi, making it the strongest 68Ge/68Ga generator in the world and complies with all the specifications of the European Pharmacopoeia for use. It is noteworthy that this generator is currently being produced at the Atomic Energy Organization of Iran (Pars Isotope Company), and it not only meets all the needs of the country's nuclear medicine centers but is also being exported to other countries.

The Third Place
Applied Research

Scientific Committee: Electrical and Computer Engineering

Research Work Title

Manufacturing a Micro-CT Scanning Device for Imaging the Microstructures of Various Small Prototypes

Representative: Dr. Hossein Ghadiri Harvani

Collaborators: Dr.Saeed Sarkar, Kamran Gholami, Mohammad Sina Sadeghi, Nagar Satarzadeh, Fatemeh Asadi, Rezvaneh Afifezadeh

Organization: Matin Behin Negareh Imaging Technology Company

Abstract:

The industrial micro-CT scanning device, branded as LOTUS-NDT, is one of the most advanced imaging tools available. Utilizing X-rays, it captures three-dimensional images of objects with micrometer-level resolution from a variety of samples. CT devices are generally categorized into three types: medical CT, industrial CT, and micro-CT. Micro-CT differs from the other two in terms of resolution and application. Specifically designed for imaging small and precise samples, micro-CT can deliver 3D images with a resolution of less than 2 micrometers without causing any damage to the samples. The range of applications for micro-CT is wide across multiple disciplines. In electrical engineering, it enables three-dimensional imaging of internal components and sensitive integrated circuits. In materials engineering, micro-CT facilitates examination of the properties of specific materials at the micron scale, and allows for the analysis of the impact of voids on damage mechanisms, as well as the study of microstructures and defects formed during production processes. The oil and gas industry benefits from 3D-micron imaging of rock samples and reservoir cores, facilitating digital rock analysis and optimizing exploration and extraction processes. In biomedical engineering and biomaterials, micro-CT plays a critical role in micron-level imaging of tissues, characterizing scaffolds, teeth, implants, and stents, while also assessing scaffolds for bone regeneration and bone structures using tissue engineering cells. Furthermore, in geology and palaeontology, micro-CT allows for the creation of 3D and 2D images of minerals and fossils without causing any damage.

The Third Place
Applied Research

Scientific Committee: Information and Communication Technology

Research Work Title

Modern Integrated Operations Monitoring Platform

Representative: Dr. Abolhassan Shamsaie

Collaborators: Dr.Mahmood Mollaei, Pedram Beheshti

Collaborating Organization: Behpaya Information Technology Company

Abstract:

The Modern Integrated Operations Monitoring Platform is an innovative solution for smart service monitoring, enhancing operational and business intelligence for online service providers in the IT sector. Its primary objective is to ensure the continuous delivery of high-quality services. Achieving sustained delivery of a quality service requires stability, optimal availability, and efficient performance of all components involved in service delivery. Therefore, ensuring the quality and efficiency of a service necessitates the continuous monitoring of all influencing components within that service. This platform enables independent monitoring of all influencing components within a service, while also allowing for integrated monitoring by mapping a graph of these components and their interconnections. Utilizing this graph, the platform facilitates root cause analysis and provides insights into Service Level Agreements (SLAs). Monitoring on the platform is conducted at three levels:

- **Computing Infrastructure Monitoring:** This encompasses performance monitoring of network devices, physical servers, storage devices, virtualization tools, various operating systems, and data center facility equipment
- **Application Infrastructure Monitoring:** This includes the performance monitoring of databases, web servers, application servers, message queue systems, service provisioning tools, orchestration tools, and enterprise tools.
- **Business Applications Monitoring:** This includes monitoring of business services, service operations, application performance, and user experience.

The Third Place
Research & Development
Scientific Committee: Chemical Technologies

Research Work Title

Synthesis of Topiramate Drug Substance

Representative: Professor Farajollah Mohanazadeh

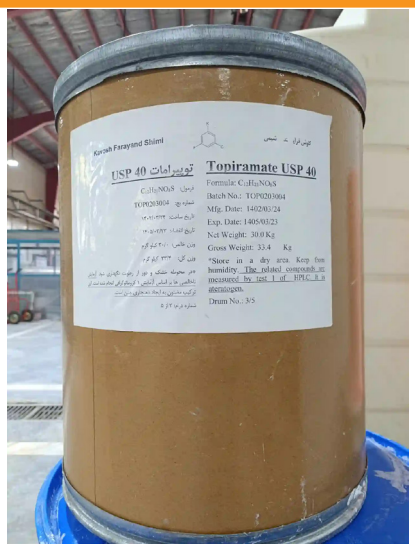
Collaborator: Elnaz Mohammadi

Organization: Iranian Research Organization for Science and Technology, Kavosh Farayand Chemi Co.

Abstract:

Topiramate, marketed under the brand name Topamax, is an oral medication used to treat epilepsy and prevent migraines, as well as to address alcohol dependence and essential tremors. It is a compound with the chemical formula C12H21NO8S, existing as a crystalline powder with a melting point of 124-125 °C. This drug represents a new generation of antiepileptic medications whose usage is steadily increasing worldwide each year, gradually replacing older medications such as carbamazepine. In this project, Topiramate was synthesized and purified using diacetone fructose and sulfamide as the primary starting materials, along with eight additional chemicals. The characteristics of the active pharmaceutical ingredient produced comply with international pharmaceutical pharmacopoeias, including the United States Pharmacopeia and the British Pharmacopoeia. The pharmaceutical ingredient is produced industrially in accordance with USP 41 standards and meets the needs of the country. Kavash Faradayn Chemi Company is the sole producer of the Topiramate's active ingredient in Iran.

- Conducting stability tests
- Obtaining Common Technical Document (CTD) approval from the FDA
- Obtaining approvals from the General Directorate of Laboratories of the Ministry of Health, Arya Pharmaceuticals, and Darupakhsh
- Mass production
- Saving 62% on foreign exchange currency



The Third Place
Research & Development

Scientific Committee: Water Management, Agriculture and Natural Resources

Research Work Title

Design and Implementation of an Intelligent Water Management System in Agriculture

Representative: Dr.Parvaneh Asgarinia

Collaborators: Dr. Mahdi Gheysari, Alireza Gheysari, Dr.Mahboubeh Ghobadi, Ali Akbar Gheisari, Hassan Gholami, Shahabodin Gheisari, Mohammad Reza Zaghian

Organization: Middle East Paidar Kesht Hoosh (MEPKO)

Collaborating Organization: Isfahan University of Technology

Abstract:

The intelligent irrigation management technology, branded as Baba Heider, is an online web application developed using AI, remote sensing, and crop modeling. It takes into account the farm's geographic and climatic conditions, as well as the physical and chemical properties of soil and water, technical specifications of the irrigation system, emitter flow rates and pressures, planting dates, crop patterns, and plant varieties. By calculating real-time water requirements of plants during their growth period or analyzing data from soil moisture sensors, Baba Heider provides a smart irrigation schedule tailored to the specific crop, either automatically or upon request. The system allows farmers to input their preferences regarding water quantity and timing constraints, generating an interactive and tailored irrigation plan for each plot of land, ranging from 1,000 square meters to 100 hectares. Additionally, it offers frost warnings and forecasts on weather conditions, soil moisture, and evapotranspiration rates. At an advanced and customized level, it can optimize irrigation and nitrogen fertilizer management, as well as planting dates, for entire villages, agro-industrial complexes, or rural cooperative organizations within a specific region. This optimization is based on climate conditions, the hydraulic characteristics of the irrigation network, water and soil quantity and quality, and crop types and varieties. Ultimately, Baba Heider enables smart farming and irrigation practices at the field level, improving water productivity, crop yields, and farmer profits while minimizing equipment damage. The system is a management tool that operates on the farmer's existing infrastructure without requiring additional investment. It is a timeless product that improves over time as its data bank grows, and passive defense measures have been incorporated into its processes and system development. Considering the effectiveness of intelligent irrigation management in increasing production, enhancing water use efficiency, boosting farmer profitability, and, most importantly, reducing the cost of production, as well as the very low investment required for smart irrigation management compared to the infrastructure investments and economic costs associated with developing modern irrigation systems and current investments in seasonal cultivation, Baba Heider represents the best sustainable approach to increasing the self-sufficiency coefficient of agricultural products.

Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Laureates of the 26th Khwarizmi Youth Award

The First Place
Applied Research

Scientific Committee: Water Management, Agriculture and Natural Resources

Research Work Title

Implementation of an AI-Based Loss Reduction System in Agricultural Harvesters

Researcher: Ali Mansoorabadi

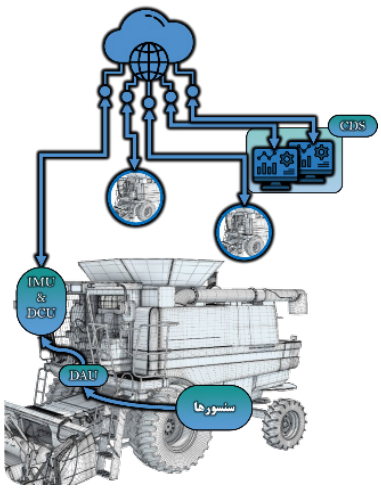
Supervisor: Hossein Pakniat

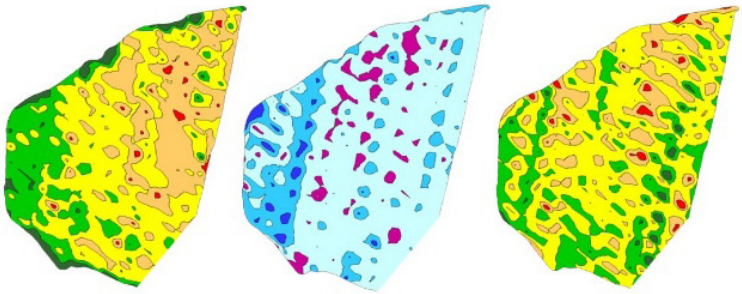
Advisor: Seyed Mahdi Nasiri

Collaborating Organizations: Pars Agriculture Technology Development Co., BPL Laboratory of Shiraz University

Abstract:

Agriculture is a three-stage process, and combine harvesters, as the primary machinery for grain harvesting, play a significant role in the overall productivity of agricultural sector. In Iran, there are approximately a few thousand agricultural combines, and due to the lack of optimal parameter control, 5.2% of the crop -valued at $173 million based on the wheat production rate and price for the 2023–2024 agricultural year- is wasted due to spillage and pulverization. This issue is exacerbated by Iran's climatic conditions and the constraints on water and soil resources. This system employs several sensors and six artificial intelligence algorithms to collect and analyze real-time performance data from the combines and consists of four main units: 1.Data Acquisition Unit (DAU) - 2.Information Monitoring Unit (IMU) - 3.Data Communication Unit (DCU) - 4.Central Monitoring Server (CMS). By analysing real-time field conditions and various parameters of the combine, the system predicts crop losses and suggests optimal settings to the driver to minimize waste. Additionally, by aggregating data from each field, three heat maps are generated based on height, moisture, and performance of different sections of the field. These maps are highly effective for improving cultivation practices, resource distribution, and field productivity in subsequent years. The results indicate that crop losses in combines equipped with this system are reduced by up to 70% with loss percentages of total yield being 3.46% in standard combines compared to 5.85% in straw-chopping combines. Additionally, the time required to harvest a given area is decreased by minimizing overloading and repair-related downtimes. Credible research also demonstrates that utilizing heat maps for field performance and adjusting planting models, irrigation, and fertilizer distribution accordingly can increase crop yields by over 30%.





The Second Place
Applied Research
Scientific Committee: Mechatronics

Research Work Title

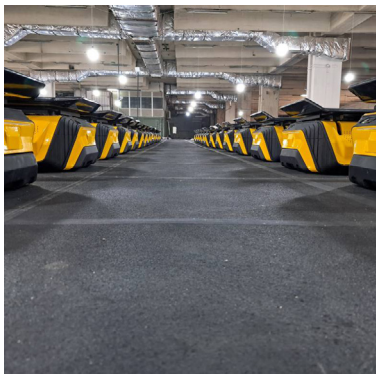
Postal Parcel Sorting Robot

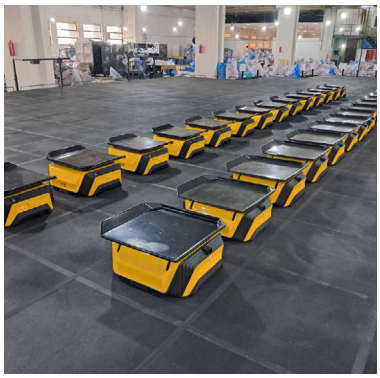
Researcher: Sasan Mohammadi

Collaborators: Reza Danaei Zadeh, Hossein Pourshamsaei, Hassan Nasiri

Abstract:

Nowadays, the role of robots in assisting humans with various tasks has become prominent and is growing increasingly significant. One functional application of robots is their capability for intelligent sorting. Postal sorting robots have revolutionized the postal industry due to their high speed and accuracy. In addition to these advantages, their flexible structure allows for easy relocation from one place to another, and they occupy minimal space while providing high efficiency in sorting large volumes of parcels. From a technical perspective, the intelligent parcel sorting system operates as follows: the robot is stationed at the entry gate, where an operator places postal packages on the robot's tray. Using cameras and artificial intelligence algorithms powered by a local server, the system detects the location of the postal barcode on the package. After identifying the package's destination and communicating it to each robot through the server, the robots use AI algorithms to navigate optimally from the entry gate to the specified destination while avoiding collisions with other robots. After several hours of operation, as the battery voltage decreases, the robots automatically head to the charging station and return to operation once fully charged. This robotic auto-charging system has been uniquely designed and implemented for the first time in Iran. At the Iranian National Post Company, the sorting process has traditionally been carried out manually by a large workforce, resulting in low efficiency due to high levels of physical and mental fatigue. Some parcels are sorted using a conveyor belt sorting machine that was previously purchased for the main postal sorting center. However, this device cannot sort envelopes, which is a notable disadvantage, along with the large space it occupies. Since March 10, 2024, our postal sorting robots have been operating continuously and have sorted millions of parcels without any errors up to today, October 6, 2024. We have successfully automated the traditionally manual postal process.





The Third Place
Applied Research
Scientific Committee: Electrical and Computer Engineering

Research Work Title

Advanced Vehicle Cluster

Researcher: Seyed Pouria Mohtashami

Collaborators: Hamed Pourvali Moghadam, Alireza Jafari, Ebrahim Pirmardvand Chegini, Amir Hossein Naderi, Mehdi Tanoorsaz, Mehran Memarnejad

Collaborating Organization: Special-Purpose Technology Development Company

Abstract:

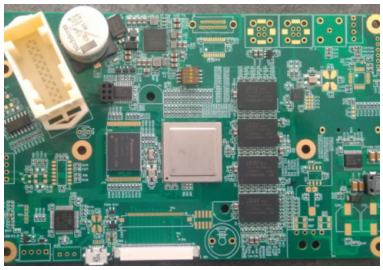
In modern vehicles, the display of information to the driver encompasses a set of advanced data and features aimed at improving the driving experience and enhancing safety. With the advancement of driver assistance systems, the need for more relevant data to be displayed while driving is becoming increasingly clear. This is especially important in navigation and interaction with other systems in new vehicles.The digital cluster product, which is an advanced unit for displaying all vehicle information to the driver, is introduced as a replacement for traditional dashboards. This product offers the following features:

- **Theme and Color Customization:** The ability to change themes and colors according to the vehicle and user preferences with high resolution and refresh rate.
- **Augmented Data Display:** Providing additional information to assist driving.
- **Display Adaptation:** Adjusting the display based on the capabilities available in the vehicle.
- **High-Speed Communication:** Enabling fast communication for displaying more data.

One of the main challenges in this area is the need for high graphical processing power and suitable power consumption. In situations where the vehicle is solely powered by a battery, managing energy consumption and providing a short standby time are considered strengths of the hardware and software coordination in this design. This digital cluster is designed with two CAN Bus interfaces compatible with the vehicle network and connects to the vehicle with a single connector, allowing for the replacement of traditional clusters. For new features such as camera image input, separate connectors have also been considered. Overall, the digital cluster not only displays vital vehicle information clearly and attractively, but it also enhances the driving experience and increases safety with its advanced capabilities.

Installed on the Tara Vehicle

Mechanical Housing



Hardware board

The Third Place
Applied Research
Scientific Committee: Arts

Research Work Title

Marbling Art in Ceramics to Create Functional and Artistic Objects

Researcher: Zeinab Abedian Jelodar

Abstract:

Marbling art is an authentic and widely used traditional technique for decorating various surfaces, with designs that often resemble marble veins. This project focuses on creating new and efficient applications of this Iranian-Islamic art, which represents the cultural identity of every Iranian. The aim is to utilize marbling art and the effects of its designs in modern decorations on ceramic substrates such as vessels and tiles, tested as samples on earthenware bodies capable of withstanding temperatures up to 1100 degrees Celsius. By combining this art with ceramic pieces, we not only enhance beauty and decoration but also emphasize its practical aspects. This approach will facilitate the broader expansion and promotion of marbling art to meet the needs of contemporary society. According to studies conducted in this field, the common methods of marbling art on ceramics have proven ineffective due to two main issues encountered during the firing process of the pieces. First, the coloring agent, which has a lower density and is typically organic in origin, tends to disappear after firing in the kiln, rendering it ineffective on ceramics. Second, the materials commonly used as color binders in marbling techniques often release the color excessively into the glaze liquid, resulting in minimal impact on the ceramic body. In this research, an efficient coloring process and formula were developed to apply marbling art on the surface of ceramic bodies. This project introduced and tested a coloring method that combines organic and inorganic materials to create marbling art using underglaze, on-glaze, and single- glaze techniques on ceramic bodies.

The Third Place
Basic Research

Scientific Committee: Advanced Materials, Metallurgy and Renewable Energies

Research Work Title

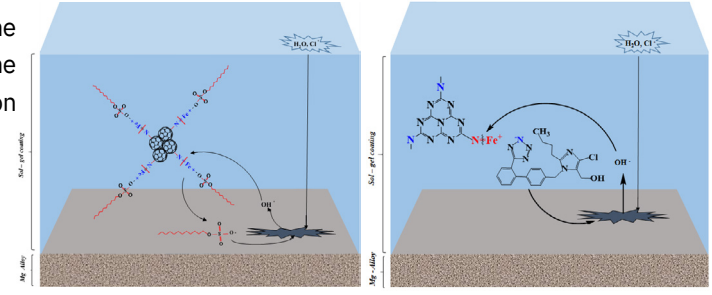
Corrosion Protection of Magnesium Alloys Using Smart Nanocomposite Coatings

Researcher: Dr.Roghaye Samadianfard

Collaborating Organization: University of Mohaghegh Ardabili

Abstract:

The aim of this project was to find an easy, non-toxic, and cost-effective method to enhance the corrosion resistance of the magnesium alloy AM60B. This enhancement would significantly increase the applications of this alloy across various industries, such as aerospace, automotive manufacturing, sports equipment, and portable digital devices. Therefore, the main objective of this project was to address one of the fundamental challenges of this lightweight alloy: its low corrosion resistance. To achieve this, sol-gel coatings were chosen because they are entirely non-toxic, solvent-free, and can be applied via a simple dip-coating method. However, despite their advantages, sol-gel coatings possess inherent porosity, which diminishes their corrosion resistance. Due to the high electrochemical activity of magnesium alloys, even low porosity in the coating can lead to significant corrosion damage. A suitable strategy to address this challenge is to incorporate corrosion inhibitors into the coating to protect the defected areas. However, the direct addition of corrosion inhibitors into the sol-gel coatings is ineffective due to their dissolution in corrosive media, resulting in uncontrolled release, and adverse chemical interactions with the silica matrix. Instead, corrosion inhibitors can be released from nanocarriers due to various internal and external factors, such as pH changes and mechanical damage. Among the different factors that trigger the release of corrosion inhibitors, pH change is particularly suitable for corrosion protective coatings because the corrosion process induces local pH changes. Therefore, in this work, we aimed to enhance the corrosion resistance of these coatings on magnesium alloys through a smart and controlled method by stabilizing suitable corrosion inhibitors on nanocarriers. Smart sol-gel coatings sensitive to pH changes were prepared using Fullerene C60 and g-C3N4 nanostructures as nanocarriers for the corrosion inhibitors sodium dodecyl sulfate and losartan potassium in hybrid sol-gel coatings. These coatings were then applied as a smart nanocomposite coating on the magnesium alloy. After immersing the magnesium alloy samples in a corrosive solution of 3.5 wt.% NaCl and simulated acid rain (pH = 1.3), the corrosion process begins when the corrosive electrolyte reaches the alloy surface through defects, leading to local alkalinity. The weak chemical bond between the inhibitor and the nanocarrier is broken, allowing the corrosion inhibitors to be released. The released inhibitors are readily absorbed at active cathodic sites and effectively inhibit the corrosion process. To confirm the smart release of corrosion inhibitors, UV-visible measurements were conducted at various pH levels. The results demonstrated that the release of corrosion inhibitors from the nanocarriers is a pH-dependent process, with maximum release observed at alkaline pH levels of 10 to 12. Additionally, the polarization resistance of the coatings containing nanocarriers stabilized with corrosion inhibitors increased over immersion time in the corrosive solution. This can be attributed to the controlled release and subsequent adsorption of the inhibitors at active corrosion sites.



Schematic representation of the smart releasing of corrosion inhibitor (sodium dodecyl sulfate)

The Third Place
Basic Research
Scientific Committee: Chemical Technologies

Research Work Title

Development of an AI-Based Electrochromic Sensor for the Detection and Measurement of Antioxidants

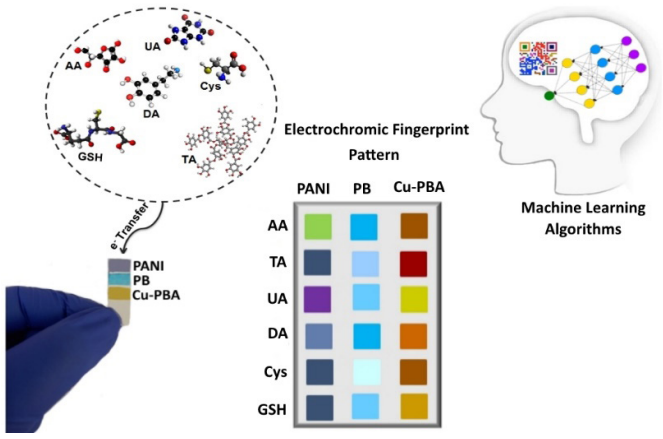
Researcher: Saba Ranjbar

Collaborators: Amir Hesam Salavati, Negar Ashari Astani, Naimeh Naseri, Mohammad Reza Ejtehadi, Navid Davar

Collaborating Organizations: National Institute of Genetic Engineering and Biotechnology, Sharif University of Technology, Amirkabir University of Technology

Abstract:

The human immune system is continuously affected by various factors that can lead to cellular mutations and oxidation, potentially resulting in chronic diseases such as cancer and Alzheimer's. Antioxidants are vital for protecting cells, reducing the risk of these diseases by mitigating damage caused by free radicals and reactive oxygen species (ROS). This underscores the importance of identifying and measuring antioxidant levels in the body to maintain them within appropriate ranges. This project introduces a three-channel sensor based on electrochromic materials that can simultaneously identify and measure six antioxidants through direct electrochemical reactions, eliminating the need for multiple oxidizing and reducing agents or biological receptors. The design relies on electrochemical reactions involving electrochromic materials stabilized on a conductive, transparent FTO/glass electrode. The materials used include polyaniline (PANI), Prussian Blue (PB), and Copper Prussian Blue (Cu-PB) in a fully oxidized state, which act as electron acceptors, while various antioxidants such as ascorbic acid (AA), uric acid (UA), dopamine (DA), cysteine (Cys), glutathione (GSH), and tannic acid (TA) serve as electron donors. The interaction between these components leads to electron transfer and changes in the oxidation state of the electrochromic materials. The differences in electron affinity and donation among the electrochromic materials and the antioxidants result in distinct color changes within the sensor channels, generating unique color patterns for each antioxidant. By converting the recorded images into RGB data and integrating this data with machine learning algorithms, the sensor has been successfully utilized to identify antioxidants in biological samples, such as human serum. The results demonstrate that this method can facilitate the rapid monitoring of antioxidant levels in biological samples and enable the early detection of related diseases.



The Third Place
Basic Research
Scientific Committee: Chemical Technologies

Research Work Title

Development of a New Model for a Transient Electroosmotic Flow in Smart Microchannels

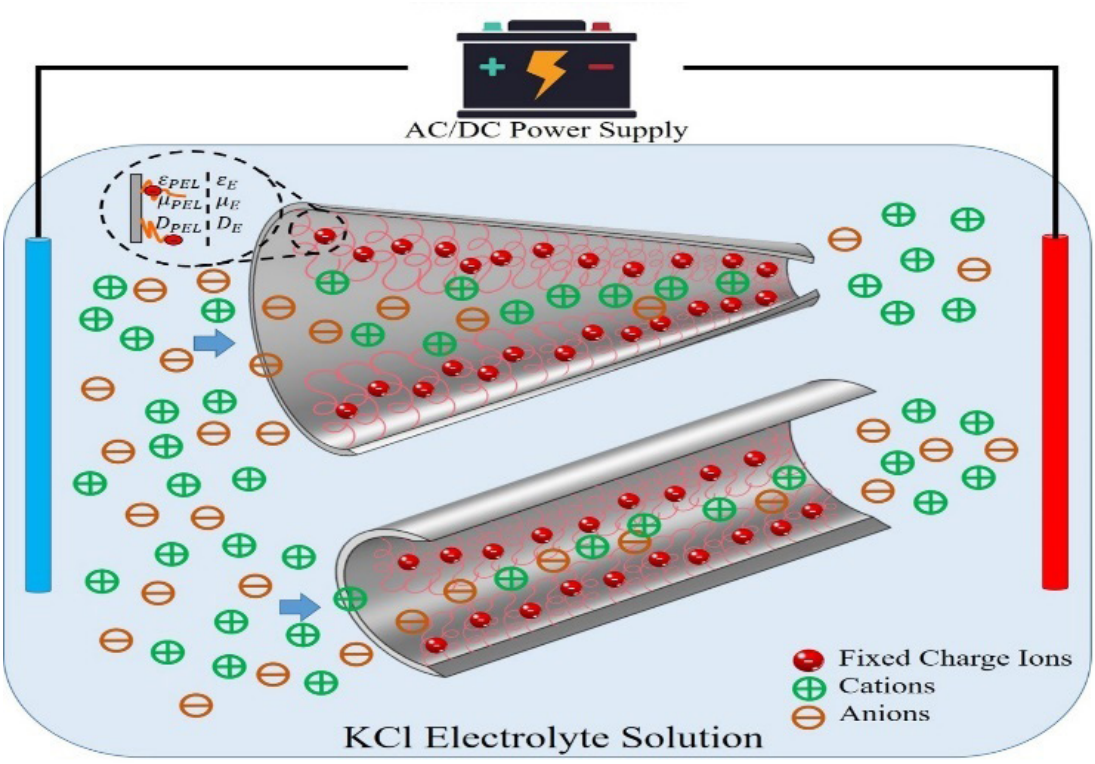
Researcher: Mehdi Khatibi

Supervisor: Seyed Nezameddin Ashrafizadeh

Collaborating Organization: Iran University of Science and Technology

Abstract:

Smart microchannels, representing one of the latest advancements in microfluidics, play a crucial role in developing high-performance devices across fields such as medicine, biology, and chemical engineering. This research focuses on development of a new model for a transient electroosmotic flow in smart microchannels to provide a deeper understanding of the complex mechanisms governing flow dynamics. Through advanced numerical simulations and mathematical analysis, the study investigates the effects of parameters such as applied voltage, channel surface properties, and electrolyte characteristics on transient flow behavior. The results reveal that precise control over electric fields and surface properties can lead to the optimized design of microfluidic systems. This study not only enhances existing processes but also opens up new opportunities for utilizing smart microchannels in technologies such as biosensing devices and drug delivery systems.



The Third Place
Basic Research
Scientific Committee: Chemical Technologies

Research Work Title

Design and Synthesis of Nanoporous Metal-Organic Frameworks with Selective Catalytic Ability

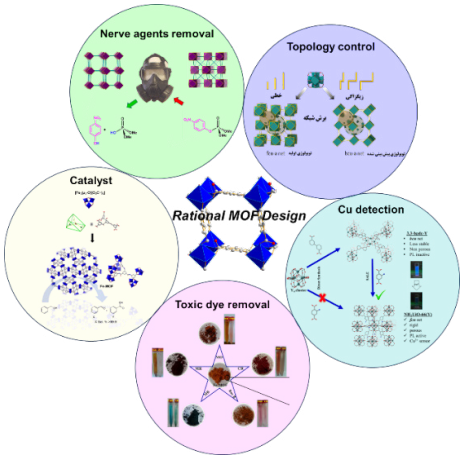
Researcher: Hossein Ghasempour

Supervisor: Ali Morsali

Collaborating Organizations: Tarbiat Modares University, Universitat Autònoma de Barcelona-Spain

Abstract:

Metal-organic frameworks (MOFs), constructed from metal ions and organic ligands, represent a new class of nanoporous materials that have shown great promise in various applications, including the adsorption and sensing of pollutants, gas capture, drug delivery, and catalytic processes. Recently, commercial technologies utilizing MOFs have been observed in the food packaging industry and for the storage of toxic gases such as AsH_3 and PF3. Despite these remarkable properties, controlling the geometric arrangement (topology) of MOFs remains one of the main challenges associated with these materials. Therefore, this research project focuses on managing topology and its effect on MOF performance, introducing and demonstrating an innovative, creative, and efficient technique for deducing the network topology of MOFs, referred to as net-clipping. The synthesized MOFs exhibited excellent capabilities in detecting and hydrolyzing organophosphorus nerve agents, adsorbing pollutant dyes, and sensing copper (II) ions, which are significant environmental hazards in today's industries. Additionally, a novel porous MOF, named Fe-MOF, has been introduced as a catalyst for the selective oxidation of alcohols to aldehydes, which is one of the most important chemical reactions. In summary, this research project encompasses the intelligent control of MOF topology to enhance their performance in four areas: (1) detection and catalytic destruction of organophosphorus nerve agents, (2) precise identification of copper ions in aquatic environments, (3) investigation of selective catalytic properties, and (4) correlation between structure and the adsorption of organic dyes. The compilation of these exceptional applications, highlights the effectiveness of this design approach and the extraordinary capabilities of porous MOF materials across a wide range in the chemical industry.



The Third Place
Innovation

Scientific Committee: Arts

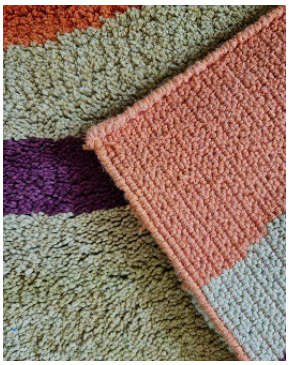
Research Work Title

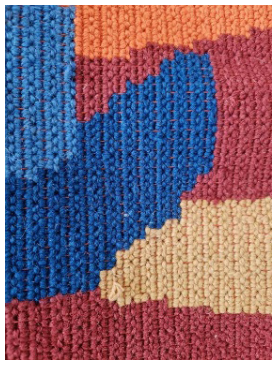
Loom-Free Handwoven Carpet

Researcher: Hanieh Alizadeh

Abstract:

Persian handwoven carpets are one of the most important symbols of Iranian culture and identity. This valuable art is not comparable to any similar or alternative product due to its high diversity in texture, design, color, material, and weaving techniques. The general structure of a handwoven carpet consists of warp, weft, and pile (knot), all made entirely from natural raw materials and woven by hand on horizontal or vertical looms. The handwoven carpet in this project is crafted from natural wool and woven with symmetrical knots; however, the foundation of the warp and weft is formed by a mesh that eliminates the stages of pulling and weeding during the weaving process. The knots are tied directly within the cells of the mesh and secured tightly. This method allows for the connection of the warp and weft to be set up within the mesh. Visually, this carpet appears indistinguishable from traditional carpets and maintains the soft and warm feel of wool. Additionally, it significantly increases the weaving speed. Due to the unique design of this type of carpet, it is possible to eliminate the need for a pre-made pattern, as the design can be drawn directly on the mesh, which saves both time and costs in the design process. This product not only does not replace traditional handwoven carpets with their original and well-known structure, but it also provides advantages, such as shorter production time, lower costs, the potential for mass production, weaving in unconventional sizes and shapes, lightweight construction, and easy washing. The carpet is particularly desirable for those who wish to use a product made from natural fibers by skilled artisans at an affordable price.





Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Secretariat Report on Khwarizmi Awards

The Khwarizmi Awards: A Mirror Reflecting National Scientific Achievements

The Khwarizmi Awards are a thoughtful approach to introducing the best national projects and recognizing outstanding scientists, researchers, innovators, and inventors who through their intellectual and practical knowledge and innovations, make today's world, with its ups and downs, brighter and more secure. These people of intellectual talent have excellent knowledge about the universe and its rules and develop scientific knowledge in many fields such as health, water management, agriculture, food resources, environment, engineering, communications, information, and the like for the betterment of their people and other nations.

The Secretariat of the Khwarizmi Awards treasures the records of projects submitted in each edition of the awards, the photos, videos, bulletins, rules and regulations, reports, and the hard and soft copies of the published documents. Today, this rich archive provides us with a valuable database that may allow the monitoring and observation of scientific development and research trends in different scientific fields over the last forty years in the country.

Considering the intellectual talents of more than 200 Iranian and foreign scientists residing in 50 countries in the world, it is realized that the Khwarizmi Awards would not only be a regular annual event, a ministerial policy, or just an international scientific event but they serve as proof of the competitiveness, and self-esteem of Iranian scholars and technologists and their constant efforts in leading the researchers and the youth to achieve sustainable development in the country. In the last 38 years, over 100 bodies, as well as private and public, scientific and economic, and national and international organizations, joined the long list of sponsors of the Khwarizmi Awards, which is another proof of these awards' competitiveness and success.

The 38th Khwarizmi International Award

The Khwarizmi International Award (KIA) was founded, in 1987, after the victory of the Islamic Revolution of Iran. Today, this scientific contest is recognized as the longest-running annual scientific award that has been held successfully for four decades in the Islamic Republic of Iran.

Given that numerous scholars collaborated on a significant number of KIA winning projects over the last four decades, it can be estimated that the community of KIA Laureates comprises several thousand members. This scientific community has excellent expert knowledge, perseverance, management skills, experience, creativity, and self-esteem, all considered valuable assets for accelerating scientific progress and developing new technologies in the country.

By examining the long list of KIA Laureates, and members of the jury and scientific committees, the experts across various scientific disciplines can discover numerous distinguished scientists listed. This serves as additional evidence of the Khwarizmi Awards' value creation, purposefulness, efficacy, and competitiveness.

The call for participation in the 38th KIA opened in the spring of 2024. The announcement was published in English on the KIA website and distributed worldwide. The deadline for submissions closed in the fall of 2024. This award encompasses basic research, applied research, and research and development projects, as well as innovation and invention initiatives across all scientific and technical fields, excluding the humanities. Evaluations are conducted at both national and international levels by 18 scientific committees.

In this edition of the award, the KIA Secretariat received over 500 applications from both Iranian and International participants, with 467 projects reviewed and assessed by the relevant scientific committees. Of these, the scientific committees recommended 31 applications to the award jury for further assessment. After conducting a thorough scientific and technical assessment of the projects and ranking the shortlisted candidates, the jury ultimately selected a total of eight national projects, along with one project from an Iranian scientist residing in the Netherlands, as the winners of the 38th Khwarizmi International Award.

The 26th Khwarizmi Youth Award

The call for the 26th Khwarizmi Youth Award commenced in May 2024, initiated by the Permanent Secretariat of the Khwarizmi Youth Award at the Iranian Research Organization for Science and Technology. This announcement was made through the award's website, the press, and various media channels, with registration for applicants closing in September 2024. More than 300 projects were submitted for the Khwarizmi Youth Award. Of these, 233 projects were evaluated by 18 scientific committees according to established criteria, and 17 projects were recommended for further assessment by the award jury.

In the end, nine projects were selected as winners of this edition of the award. This includes four projects from the basic research category in the fields of Chemical Technologies, and Advanced Materials, Metallurgy, and Renewable Energies; four projects from the applied research category in Water Management, Agriculture and Natural Resources, Electrical and Computer Engineering, Mechatronics, and Arts; and one project in the innovation category focused on the Arts.

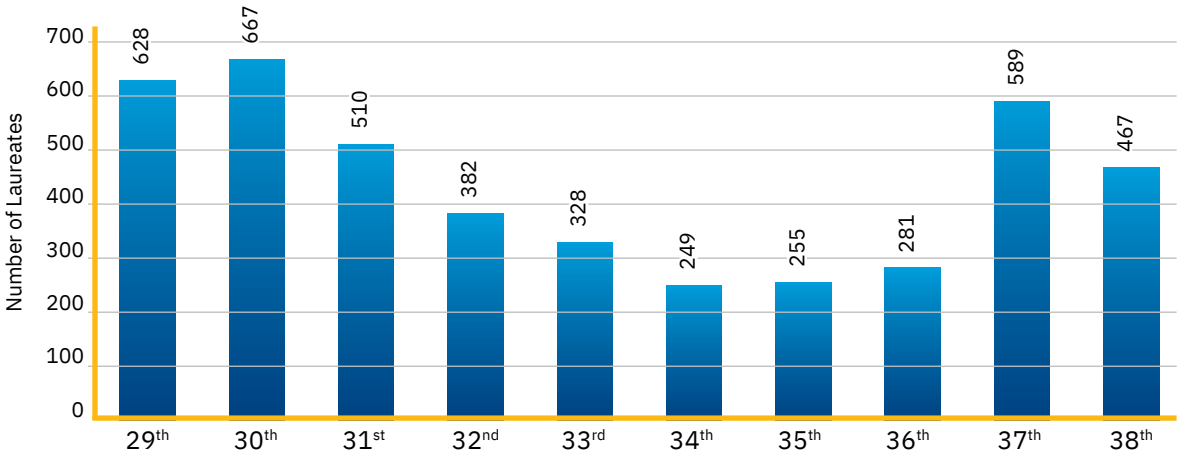
In conclusion, we would like to sincerely thank all researchers, technologists, and innovators who participated in this award. We also extend our gratitude to the members of the Scientific the Executive Committees and the many colleagues at the Iranian Research Organization for Science and Technology who greatly contributed to the excellence and success of this award edition with their efforts, expertise, commitments and responsible follow-up.

The Permanent Secretariat
Khwarizmi Awards
February 2025

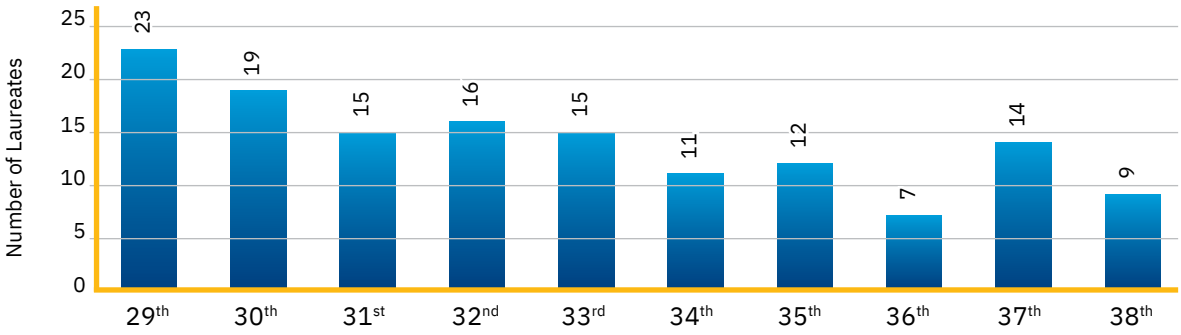
Laureates – The 38th Khwarizmi International Award

No.	Category	Scientific Committee	The First Place	The Second Place	The Third Place	Total
1	Outstanding Researcher	Mechanical Engineering	--	--	--	1
2	Research and Development	Chemical Technologies	--	--	1	1
		Water Management, Agriculture and Natural Resources	--	--	1	1
3	Applied Research	Electrical and Computer Engineering	--	--	1	1
		Information and Communication Technology	--	--	1	1
		Chemical Technologies	--	--	1	1
4	Basic Research	Chemical Technologies	--	--	1	1
		Chemical Technologies	--	1	--	1
5	Innovation	Electrical and Computer Engineering	--	1	--	1
Total						9

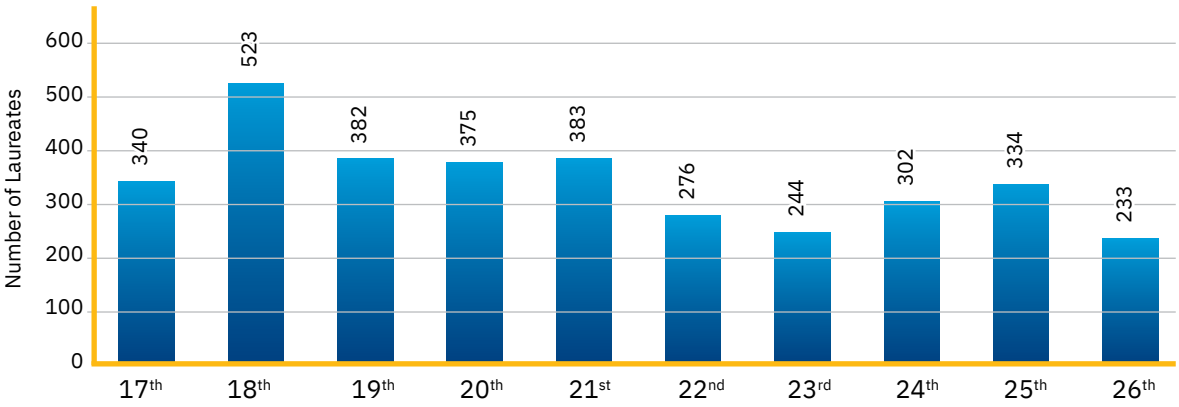
Total national and international applications over the last ten editions of the Khwarizmi International Award



Total number of Laureates over the last ten editions of the Khwarizmi International Award



Total applications over the last ten editions of the Khwarizmi Youth Award



Total Number of the Laureates over the last ten years of Khwarizmi Youth Award

Edition	17	18	19	20	21	22	23	24	25	26
Total Number	13	16	11	12	10	9	8	6	6	9

Laureates – The 26th Khwarizmi Youth Award

No.	Category	Scientific Committee	The First Place	The Second Place	The Third Place	Total
1	Basic Research	Chemical Technologies	--	--	3	3
		Advanced Materials, Metallurgy and Renewable Energies	--	--	1	1
2	Applied Research	Water Management, Agriculture and Natural Resources	1	--	--	1
		Mechatronics	--	1	--	1
		Electrical and Computer Engineering	--	--	1	1
		Arts	--	--	1	1
3	Innovation	Arts	--	--	1	1
Total			1	1	7	9

The Jury Members
38th Khwarizmi International Award

Prof. Alireza Ashori	Chairman of the 38th Khwarizmi International Award
Prof. Reza Faraji Dana	University of Tehran
Dr. Bijan Vosoughi Vahdat	Sharif University of Technology
Prof. Rahmat Sotudeh Gharebagh	University of Tehran
Prof.Mohammad Reza Soudi	Alzahra University
Prof. Saeed Balalaie	Toosi University of Technology
Prof. Mohammad Reza Naghavi	University of Tehran
Prof. Mohammad Jafar Abd Khodaei	Sharif University of Technology
Prof. Mohammad Ali Ardekani	Iranian Research Organization for Science and Technology
Prof. Seyed Mohammad Reza Khalili	Toosi University of Technology
Prof. Hamid Latifi	Shahid Beheshti University
Dr. Hossein Sarpoolaky	Iran University of Science and Technology
Prof. Ali Akbar Afzalian	Shahid Beheshti University
Prof. Peyman Salehi	Shahid Beheshti University
Prof. Mojtaba Sadighi	Amirkabir University of Technology
Dr. Alireza Allahyari	Iranian Research Organization for Science and Technology

The Jury Members
26th Khwarizmi Youth Award

Dr. Alireza Basiri	Iranian Research Organization for Science and Technology
Prof. Fereshteh Haj Esmaeil Beigi	Laser and Optics Research Institute
Prof. Mehrdad Azin	Iranian Research Organization for Science and Technology
Dr. Mohammad Abedi	Iranian Research Organization for Science and Technology
Prof. Saeed Balalaie	Toosi University of Technology
Dr.Nasrin Faghih Malek Marzban	Alzahra University
Dr. Arzhang Javadi	Agricultural Research, Education and Extension Organization
Dr. Ali Jahangiri	Shahid Beheshti University
Dr. Omid Naghshine Arjmand	Amirkabir University of Technology
Prof. Karen Abrinia	University of Tehran
Prof. Mohsen Alishahiha	Institute for Research in Fundamental Sciences
Prof. Bijan Vosoughi Vahdat	Sharif University of Technology
Prof. Saeed Olyaee	Shahid Rajaee Teacher Training University
Dr.Hossein Mirzaei	University of Tehran
Dr. Mostafa Khazaei	Technical and Vocational University/ Shariati Technical College

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Head: Dr.Ahmad Ekhlasi	Arts, Architecture & Urban Planning
Head: Dr. Marjan Rajabi	Basic Sciences
Head: Dr. Seyede Malihe Safavi	Biotechnology & Basic Medical Sciences
Head: Dr. Eslam Kashi	Chemical Technologies
Head: Prof. Omid Rezaeifar	Civil Engineering
Head: Dr. Gholam Reza Mohammad Khani	Electrical & Computer Engineering
Head: Dr. Seyed Moslem Mousavi	Industrial Engineering & Technology Management
Head: Dr. Mehran Nikarya	Information and Communication Technology
Head: Dr. Koroush Shirvani	Materials, Metallurgy & New Energies
Head: Dr.Foad Farhani	Mechanical Engineering/ Mechatronics/Aerospace

Executive Committee Members

Prof. Alireza Ashori	President, IROST
Dr. Seyed Heidar Mahmoudi Najafi	Vice President of Administration and Human Resources
Mokhtar Kazemzadeh	Advisor to the President & General Director, President's Office and Public Relations
Mohammad Reza Farahmandnezhad	Advisor to the President & General Director, Security Office
Farhang Kheiri	General Director, IT Department
Siavash Mosalmani	General Director, Administration & Human Resources
Zoya Rahimi	Head, Khwarizmi Awards Group
Fatemeh Jask	Head, International Scientific Cooperation Group
Dr.Maryam Rezaee	Senior Expert, International Scientific Cooperation
Zahra Shokri	Senior Expert, Khwarizmi Awards
Alireza Namjoo	Expert, International Scientific Cooperation
Robabeh Fasihi Azar	Secretary, International Scientific Cooperation
Mahdi Safai	Expert, Khwarizmi Awards
Dr.Alireza Allahyari	General Director , International Scientific Cooperation

IROST Colleagues

Dr. Elham Gholibegloo
Sara Sehati
Zohreh Chizari
Hajar Khademi
Fatemeh Khaji
Maryam Safari

Quotes from the former Laureates of the Khwarizmi International Award

Dear Chairman,
I feel deeply honored to be a Laureate of the 37th Khwarizmi International Award, organized by the Iranian Research Organization for Science and Technology (IROST). Being a scientist from Türkiye, I am extremely grateful for the warm reception and hospitality extended by my Iranian colleagues and scientists. It is my sincere hope that this award program and ceremony will serve as a bridge that connects the two great Islamic cultures and nations.

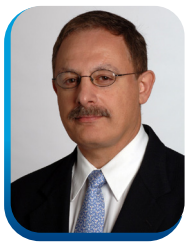
Prof.İlhami Gülçin
Ataturk University, Türkiye

Dear Chairman,
I am delighted and honored to be the Laureate of the 36th Khwarizmi International Award in 2022. I wish to thank you warmly.

Prof. Jean-Laurent CASANOVA
Rockefeller University and the University of Paris; Laboratory of Human Genetics of Infectious Diseases, France

Dear Chairman,
Thank you to the Khwarizmi International Award committee and the jury members for bestowing upon me the prestigious 34th Khwarizmi International Award. I am honored and humbled to receive this international award from the jury. This award enormously enhances our cooperation with scientists in Iran in establishing the technology base for producing high-efficiency, large-area, all-printable perovskite solar cells, and their integration into photovoltaic modules for renewable energy applications.

Prof. Mohammad Khaja NAZEERUDDIN
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland



Dear Chairman,
I have been granted many awards in my 40-year career as a distinguished professor of electrical engineering. However, KIA has a special place in my technical portfolio and is manifested as a significant recognition of my contributions to engineering and science, which I will cherish for the rest of my life.

Prof. Seyed Mohammad SHAHIDEHPOUR
Illinois Institute of Technology, Iranian Resident in the U.S.A

Dear Chairman,
It is a great honor to become this year's KIA laureate. Science and technology can transcend cultures, languages, and borders. I am proud to be a member of the international KIA community. I hope that the award leads to scientific collaboration and exchange of students between Iran and Australia. Thank you, KIA organization.

Prof. Katharina GAUS
University of New South Wales, Sydney, Australia

Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Sponsors of the Khwarizmi Awards and the Messages

International Sponsors

Logo	Title
	World Intellectual Property Organization (WIPO)
	Iranian National Commission for UNESCO
	Commission on Science and Technology for Sustainable Development in the South (COMSATS)
	Organization of Islamic Cooperation Standing Committee on Scientific and Technological Cooperation (COMSTECH)
	Asian and Pacific Centre for Transfer of Technology (APCTT)

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PPC شرکت پتروشیمی پردیس Pardis Petrochemical Company	Pardis Petrochemical Company
شرکت مخابرات ایران	Telecommunication Company of Iran
بنیاد ملی علم ایران Iran National Science Foundation	Iran National Science Foundation

The Prizes and Certificates of the Khwarizmi Awards

The Ministry of Science, Research and Technology

Certificates

The Presidency of the I.R. Iran

Certificates

Iranian Research Organization for Science and Technology

The Khwarizmi Award Trophy, valuable cash prizes and Certificates

National Elite Foundation

Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

Messages from The Sponsors of the Khwarizmi Awards

Pardis Petrochemical Company

The Khwarizmi International Award (KIA) is the most important scientific and technological event in the Islamic Republic of Iran. Within four decades of continuous organization of KIA, this award has become a mirror reflecting the nation's scientific and technical achievements. Pardis Petrochemical Company (PPC) is proudly one of the main sponsors of this edition of the award and has also had extensive participation in introducing and disseminating KIA call for applications among petrochemical companies in the South Pars region. PPC extends its congratulation to the laureates of the 38th Khwarizmi International Award and wishes them continued success and prosperity.

The petrochemical industry plays a crucial role in our economies by producing a wide range of materials that fuel various sectors, including agriculture, healthcare, and consumer goods. Recently artificial intelligence (AI) has become a revolutionary innovation. By demonstrating its value - from improving process efficiency to preventive maintenance and optimizing supply chains - AI has played an invaluable role in transforming the landscape of the petrochemical industry. Some of the advantages of AI include:

1. **Process Optimization and Efficiency:** AI is capable of analyzing large volumes of data generated during various processes. With the use of AI, it becomes possible to monitor and optimize complex operations simultaneously.
2. **Supply Chain and Inventory Management:** AI enables demand forecasting and inventory optimization. Petrochemical factories deal with various raw materials and final products. By analyzing market trends and external factors, it becomes easier to ensure inventory levels and continuous supply of essential materials; this simplifies current logistics, reduces storage costs, and improves responsiveness to market demands.

Given the aforementioned advantages of artificial intelligence (AI), PPC has designed and implemented a new AI-based software to enhance efficiency in its operations, maintenance, and commercial sector.

Dr. Seyed Mohammad Reza Miri Lavasani
Managing Director
Pardis Petrochemical Company

World Intellectual Property Organization (WIPO)

On behalf of the World Intellectual Property Organization (WIPO), I extend my warmest congratulations to the laureates of the prestigious the 38th Khwarizmi International Award (KIA) and the 26th Khwarizmi Youth Award (KYA).

Muḥammad ibn Mūsā al-Khwārizmī's work in algebra and algorithms, published nearly 1,200 years ago, continues to shape modern society, underpinning the digital age and Artificial Intelligence (AI).

As the UN agency dedicated to innovation and creativity, WIPO recognizes Intellectual Property (IP) as a key driver of economic growth and social progress. Countries like the Islamic Republic of Iran are increasingly integrating IP into their national development strategies.

Iran's 2024 Global Innovation Index (GII) ranking—64th among 133 economies and 5th among lower-middle-income nations—is commendable. Tehran also ranks among the top 100 Science and Technology clusters, with notable contributions in medical technology PCT applications.

Our collaboration with Iran has never been stronger, reflected in productive engagements, impactful projects, and ongoing discussions on its National Intellectual Property Strategy (NIPS). We take pride in supporting the collective mark for Persian carpets and branding initiatives for saffron and pistachios.

WIPO remains committed to strengthening Iran's IP ecosystem for the common good. As you build on of Muḥammad ibn Mūsā al-Khwārizmī legacy, we wish you continued success.

Daren Tang
Director General
WIPO

Iranian National Commission for UNESCO

On behalf of the Iranian National Commission for UNESCO, we are honored to participate and support the organization of the Khwarizmi International Award, held annually to commemorate and recognize the greats of science and technology from all over the world. We appreciate this opportunity to stand with you in pursuit of knowledge and innovation.

The Khwarizmi International Award, as one of the most prestigious and prominent global scientific events, has, for many years, provided a suitable platform for researchers, experts, and elite individuals from around the world to come together and share the achievements in which are the result of their tireless efforts and unending search in the world of science and technology.

This Award, in addition to recognizing the outstanding roles of active individuals and groups in the field of science, offers an opportunity to exchange their unique knowledge and experience, in which plays a significant role in the development and advancement of science and technology on a global scope. In this context, by relying on the capabilities of young people and brilliant talents, new horizons of technology and research will be revealed before us.

The Iranian National Commission for UNESCO, has always believed that investing in the production of science and technology is the most fundamental and effective investment, which results in institutionalizing a culture of curiosity and innovation in society. Therefore, organizing festivals like the Khwarizmi International Award is not only a symbol of appreciation and gratitude but also a platform for raising the scientific level of the country and training a forward-thinking and creative generation.

These Awards also provide a unique opportunity to bring together the greatest minds and researchers from around the world, in which significantly strengthens scientific networking and cultural exchange amongst countries. Holding these scientific events is also influential in reinforcing research infrastructure and attracting the best and brightest talents in the country.

Wishing all participants in the Khwarizmi International Award success; we hope that this scientific event will pave the way for achieving greater scientific and technological honors and subsequently lead to the progress of our beloved homeland.

We express our sincere gratitude to all the experts who, with their efforts and dedication, in which they played a significant role in the grand organization of this festival; especially the Iranian Research Organization for Science and Technology, and wish you all success and joy.

Hassan Fartousi
Secretary General
Iranian National Commission for UNESCO

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

I am privileged and honoured to convey my warm congratulations to the laureates of the 38th Khwarizmi International Award (KIA) and 26th Khwarizmi Youth Award (KYA).

In today's rapidly changing world, the intersection of innovation and sustainable development is more important than ever. As we continue to face challenges such as climate change, resource scarcity and social inequality, innovative technological solutions are essential to creating a better future for all. From clean energy breakthroughs to digital solutions that drive efficiency, technology is the catalyst that will enable us to achieve the Sustainable Development Goals (SDGs). Areas that will need priority focus on research and innovation include clean energy transition, smart agriculture, circular economy, sustainable mobility, disaster risk reduction among others. By adopting innovative solutions across sectors, we can create a resilient and sustainable global economy.

Innovators play a pivotal role in shaping the future of our planet, and with this comes great responsibility. They must recognize that their solutions not only need to be advanced but also economically viable, socially inclusive, environmentally sustainable and ethically acceptable. The focus should be on developing long-term solutions, improving resource efficiency, reducing environmental impact, and fostering social inclusivity. Innovators need to actively engage with governments, businesses, civil society and local communities to ensure their innovations are aligned with global, national and local sustainability goals. At the Asia-Pacific regional level, the Asian and Pacific Centre for Transfer of Technology (APCTT) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) offers a collaborative platform for multistakeholder engagements and knowledge-sharing towards strengthening technology cooperation among countries. Together, we can make a difference and pave the way for a greener, more resilient future in the Asia-Pacific region.

By inspiring scientists and innovators including young researchers, the Khwarizmi Awards play a crucial role in nurturing innovative minds and creativity for scientific excellence and achievements. Once again, I congratulate and convey my best wishes to this year's KIA and KYA winners and the organizers for their hard work and commendable efforts to make this event a great success.

Preeti Soni
Head
APCTT-ESCAP

The Ministerial Standing Committee of the Organization Of Islamic Cooperation for Scientific and Technological Cooperation (OIC-COMSTECH)

I am truly delighted to learn that the Iranian Research Organization for Science and Technology (IROST) is hosting the 38th Khwarizmi International Award (KIA). Being among the distinguished laureates of this prestigious of award remains an honor and a cherished milestone in my professional journey.

I extend my heartfelt congratulations to the IROST for upholding the legacy of this exceptional award, which continues to set the benchmark for recognizing excellence and fostering innovation all fields of science and technology. The international scope of this award, combined with its openness to participants worldwide, rightfully establishes it as one of the most eminent scientific accolades originating from an Islamic country.

By transcending national and, regional and religious boundaries, this award underscores that the universal value of knowledge, particularly science and technology. The award not only encourages scientists from the Islamic world to excel at an international level but also bridges the gap between the scientific communities of the OIC region and the global research landscape. This integration enriches both sides, fostering collaboration and mutual respect.

On behalf of OIC-COMSTECH (The Ministerial Standing Committee of the Organization of Islamic Cooperation for Scientific and Technological Cooperation), and in my personal capacity, I convey my sincere congratulations to the IROST for organizing the 38th Khwarizmi International award, a testament to its unwavering commitment in promoting a culture of science and technology for global common good. I also extend my warm congratulations to this year's winners, welcoming them to the distinguished community of Khwarizmi Laureates.

Prof. M. Iqbal Choudhary, Mustafa (PBUH) Prize Laureate, H.I., S.I., T.I.
Coordinator General of OIC-COMSTECH

Commission on Science and Technology for Sustainable Development in the South (COMSATS)

On behalf of the Commission on Science and Technology for Sustainable Development in the South (COMSATS), I am honored to extend heartfelt felicitations to COMSATS' esteemed Centre of Excellence, the Iranian Research Organization for Science and Technology (IROST) for successfully holding the 38th Khwarizmi International Award (KIA). This distinguished Award continues to highlight the remarkable contributions of scientists, researchers, and innovators across the globe. It is a privilege to celebrate the groundbreaking achievements of this year's laureates, whose exceptional work exemplifies the power of Science, Technology and Innovation (ST&I) to address contemporary challenges and drive socio-economic development.

Today, the integration of ST&I into national and regional development strategies is not only crucial for addressing the challenges of our times but also for creating opportunities for sustainable growth. From combating climate change to revolutionizing industries, S&T has the potential to provide solutions that can shape a brighter future. In this connection, the role being played by the Khwarizmi International Award is admirable.

At COMSATS, we are deeply committed to fostering tech-based solutions through collaborative efforts across our 27 Member States and 25 Centres of Excellence. Our focus is to bridge the technological gap and ensure that cutting-edge innovations are accessible, particularly to the developing countries. Through various initiatives, COMSATS aims to empower countries to exploit the full potential of science and technology for sustainable development. In view of its organizational objectives and regional programs, as well as the global agenda set out by the world community in the form of SDGs, COMSATS has developed and maintained close working relations, inter alia, with The Commonwealth, entities of UN and OIC, and various international organizations, including ANSO, TWAS, ICGEB, The South Centre, PIDF and INSME.

COMSATS is a proponent of driving eco-friendly innovations. With its indigenously developed technology, it has initiated to convert the Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs) through retrofitting. A multi-dimensional initiative of Social, Economic, Health and Environmental benefits for the people and the country of its adoption. Adaptation of EV in place of ICE vehicles using locally manufactured EV kits will save hundreds of millions of dollars every year in a country importing petroleum, divert this resource to the industrial sector to increase national productivity, achieve SDGs 7 and 13 with reduction in CO2 emission, earning Carbon Credit in return, health improvement, aspect of Corporate Sector Responsibility (CSR), and savings to a family of modest means on petrol which could be diverted to better education and nutrition.

As we recognize the achievements of this year's KIA laureates, it is essential to acknowledge the broader impact of their work on global advancements in science and technology. We must keep ourselves abreast of the latest S&T developments taking place around the world that have the potential of shaping our future. For instance, the Chinese Academy of Sciences (CAS) achieved the first successful cloning of a rhesus monkey, a groundbreaking milestone in genetics and neuroscience. The Jiufengshan Laboratory in China made significant progress in silicon photonics chip technology, greatly improving data transmission efficiency. In Morocco, Mohammed VI Polytechnic University introduced energy-efficient desalination technology, offering innovative solutions to address water scarcity and support agriculture in arid regions. Similarly, Vertex Pharmaceuticals and CRISPR Therapeutics received approval for the first CRISPR-based therapy, promising to revolutionize the treatment of sickle cell disease and beta-thalassemia, with potential applications for other genetic disorders. Such advancements exemplify how technological progress can enable countries to leapfrog and provide solutions to some of the most pressing global challenges.

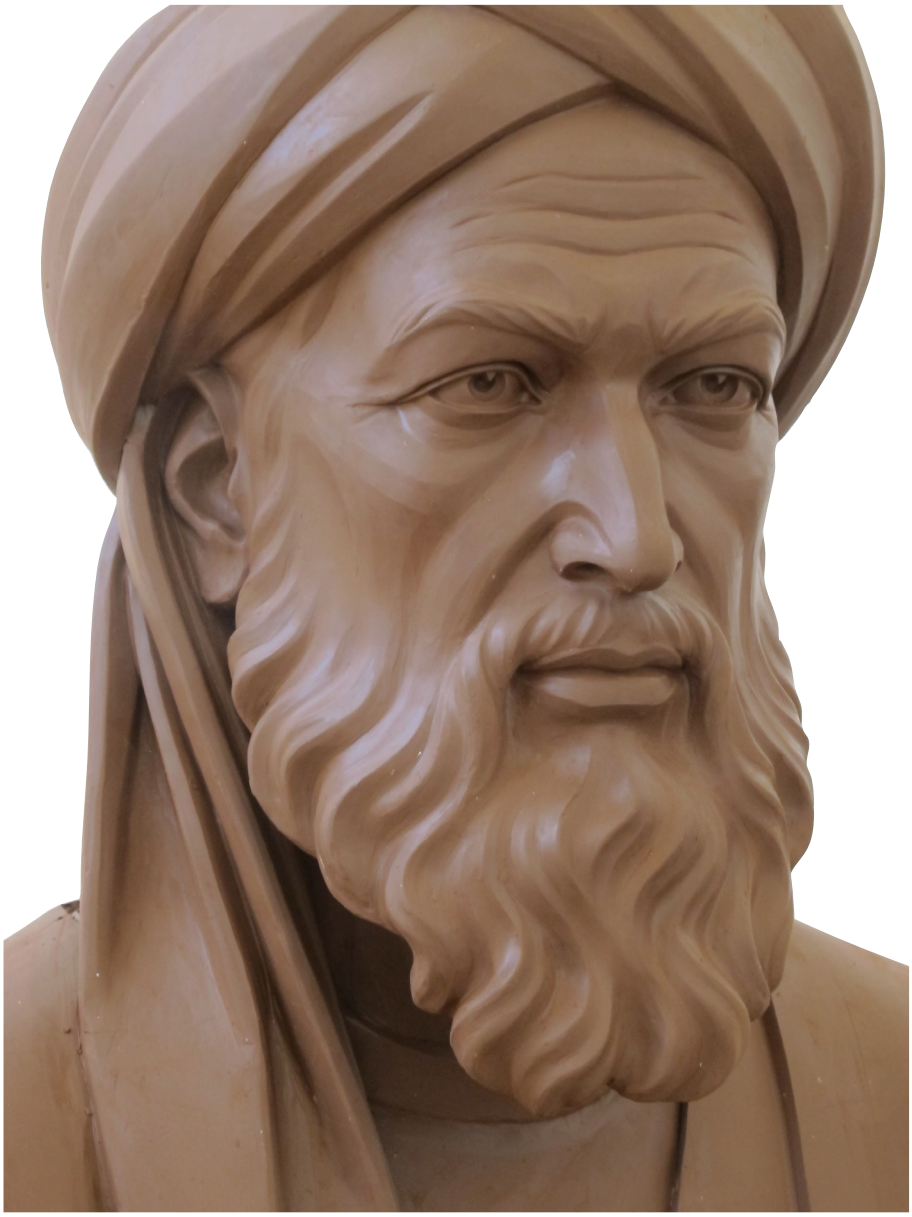
Artificial Intelligence (AI) has emerged as a transformative force in the realm of science, technology and innovation, enabling more efficient and impactful solutions across various sectors. In biotechnology, for instance, Google DeepMind and Isomorphic Labs have introduced AlphaFold 3, a revolutionary AI model that has significantly advanced our ability to predict protein structures, accelerating drug discovery and providing deeper insights into molecular interactions. Similarly, GPT-4, another cutting-edge AI model, is enhancing multimodal interaction across industries, particularly in healthcare. These advancements underscore the need for greater international collaboration in AI to ensure that these technologies benefit humanity on a global scale.

As we move forward, it is essential that we continue to prioritize the development and application of science and technology in ways that are not only innovative but also inclusive and equitable. The winners of the 38th KIA have demonstrated how scientific inquiry and technological innovation can create a positive and lasting impact. Their achievements inspire us all to remain committed to the pursuit of knowledge and the betterment of society.

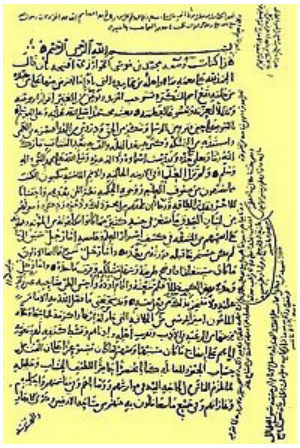
Once again, I congratulate the winners of the 38th Khwarizmi International Award and commend all those who continue to work tirelessly toward advancing the frontiers of science and technology for the benefit of humanity.

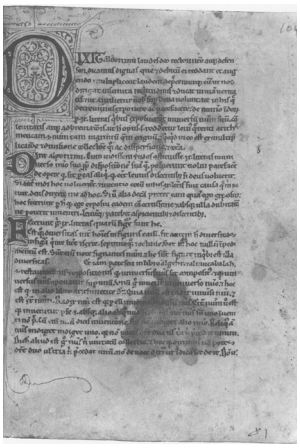
Ambassador Dr. Mohammad Nafees Zakaria
Executive Director
COMSATS

The Biography of Muhammad ibn Musa Khwarizmi



Muhammad ibn Musa Khwarizmi was a Persian Muslim mathematician, astronomer, astrologer and geographer. He was born in Persia of that time and died around 850. Historians have different interpretations on his life and the origin of his name Khwarizmi. He studied and wrote many books and treatises. His Algebra was the first book on the systematic solution of linear and quadratic equations. Consequently Khwarizmi is to be considered to be the father of algebra. His contributions not only made a great impact on mathematics, but on language as well. The word algebra is derived from al-abr, one of the two operations used to solve quadratic equations, as described in his book. The words algorism and algorithm stem from algoritmi, the Latinization of his name.





Contributions

His major contributions to mathematics, astronomy, astrology, geography and cartography provided foundations for later and even more widespread innovation in algebra, trigonometry, and his other areas of interest. His systematic and logical approach to solving linear and quadratic equations gave shape to the discipline of algebra, a word that is derived from the name of his book on the subject named "The Compendious Book on Calculation by Completion and Balancing". This book was first translated into Latin in the twelfth century.

His book on the Calculation with Hindu Numerals was principally responsible for the diffusion of the Indian system of numeration in the Middle-East and then Europe. This book also translated into Latin in the twelfth century, as Algoritmi de numero Indorum. From the name of the author, rendered in Latin as algoritmi, originated the term algorithm. Khwarizmi systematized and corrected Ptolemy's data in geography as regards to Africa and the Middle east. Another major book was his Kitab surat al-ard ("The Image of the Earth"; translated as Geography).

He also assisted in the construction of a world map for the caliph al-Ma'mun and participated in a project to determine the circumference of the Earth, supervising the work of 70 geographers to create the map of the then "known world". When his work was copied and transferred to Europe through Latin translations, it had a profound impact on the advancement of basic mathematics in Europe. He also wrote on mechanical devices like the astrolabe and sundial.

Algebra

Kitab al-mukhtar fi hisab al-jabr wa-l-muqabala "The Compendious Book on Calculation by Completion and Balancing" is a mathematical book written approximately 830 CE.

Arithmetic

Khwarizmi's second major work was on the subject of arithmetic, which survived in a Latin translation but was lost in the original Arabic.

Geography

Khwarizmi's third major work is his Kitab surat al-Ard "Book on the appearance of the Earth". It is a revised and completed version of Ptolemy's Geography, consisting of a list of 2402 coordinates of cities and other geographical features following a general introduction.

Astronomy

Khwarizmi's Zij al-sindhind (astronomical tables) is a work consisting of approximately 37 chapters on calendrical and astronomical calculations and 116 tables with calendrical, astronomical and astrological data, as well as a table of sine values. This is one of many Arabic zijes based on the Indian astronomical methods known as the sindhind.

Jewish calendar

Khwarizmi wrote several other works including a treatise on the Hebrew calendar. It describes the -19 year intercalation cycle, the rules for determining on what day of the week the first day of the month Tishri shall fall; calculates the interval between the Jewish era (creation of Adam) and the Seleucid era; and gives rules for determining the mean longitude of the sun and the moon using the Jewish calendar. Similar material is found in the works of Biruni and Maimonides.