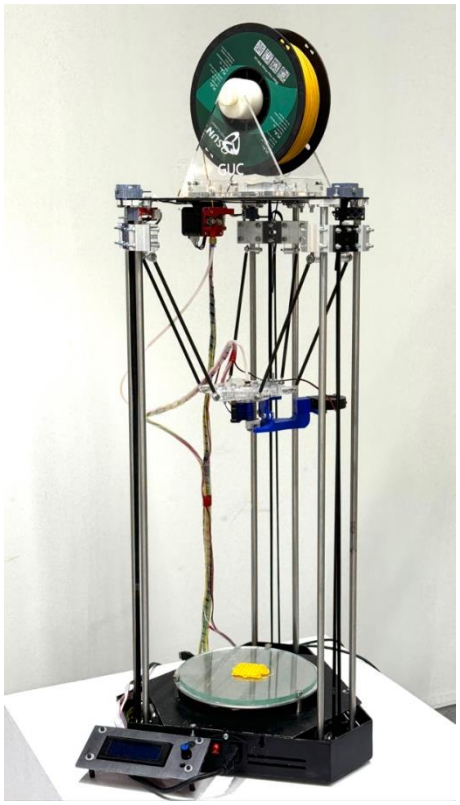
Research and Technology Exhibition

The university's research and technology exhibition is a vibrant showcase of innovation and creativity, bringing together projects from various faculties highlighting how students from various faculties work together to advance knowledge and innovation in an interdisciplinary manner. This collaborative effort reflects the university's dedication to integrating diverse fields to drive academic and practical advancements.

Delta Robot for a 3D printing application

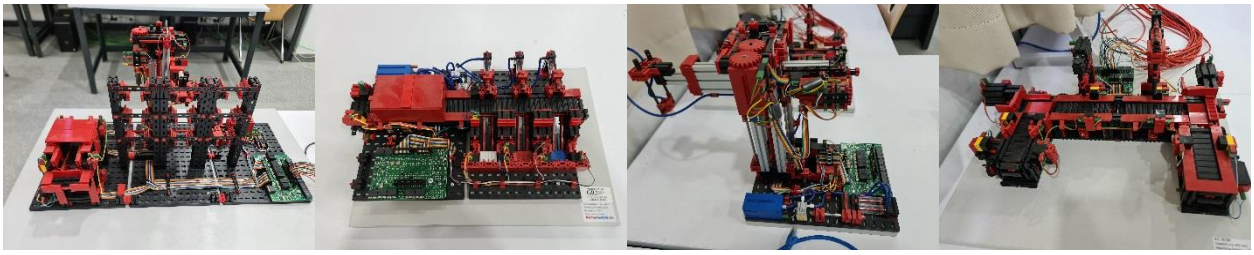
The Delta robot is a highly efficient and precise robotic arm, commonly employed in industries for tasks that demand both speed and accuracy, such as assembly, packaging, and pick-and-place operations. Its unique parallel kinematic design enables it to perform rapid movements while maintaining exceptional precision, making it an essential component in automated manufacturing systems.

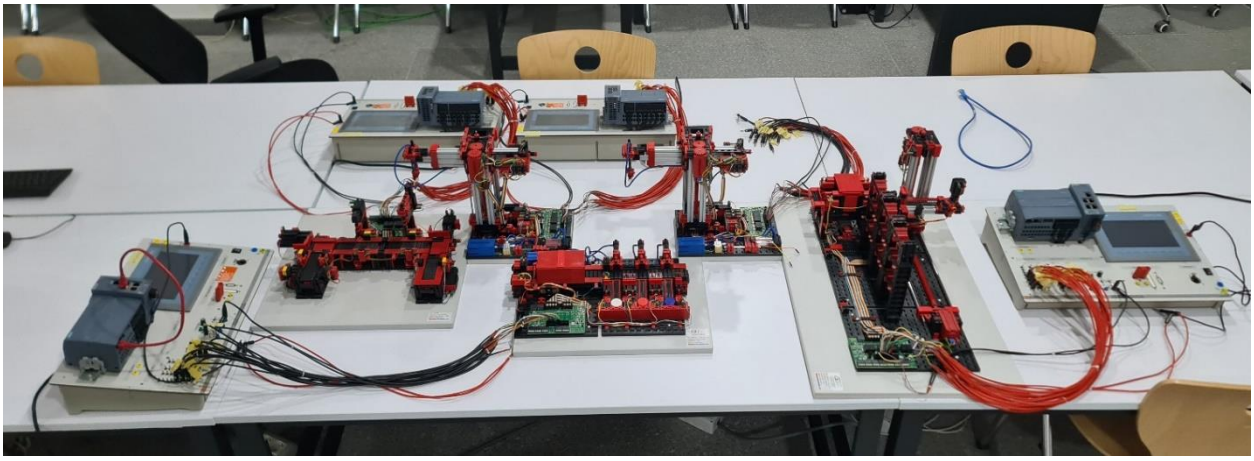
In the field of 3D printing, the Delta robot excels by enabling fast and accurate layer deposition, which results in quicker production times and improved print quality. Its ability to handle high-speed, repetitive tasks without sacrificing precision highlights its versatility in industrial applications.



This particular Delta robot was developed by students, showcasing their ingenuity and technical proficiency. The project was entirely conceived and built within the university's facilities, underscoring the institution’s commitment to fostering innovation and providing hands-on learning experiences for its students. This accomplishment reflects the students' practical understanding of robotics and automation technologies, positioning them at the forefront of modern engineering practices.

Cyber Physical System (CPS – Smart Factory)





This project serves as a comprehensive model for a smart factory, integrating advanced automation systems and robotics to demonstrate key Industry 4.0 technologies, with a forward-looking approach toward Industry 5.0.

The smart factory model includes several core components:

1. **Indexed Line**: This part of the system consists of milling and drilling stations and utilizes two sliders to move workpieces from the inlet conveyor to the machining conveyor, and then to the exit conveyor. The indexed line enables efficient and precise handling of parts during manufacturing.
2. **Colour Sorting Line**: Designed for sorting white, red, and blue workpieces, this line directs each workpiece into its respective slot, demonstrating an automated sorting process that enhances efficiency and reduces human error.
3. **Automated Warehouse**: This warehouse system is composed of storage racks that can hold up to nine product trays. A conveyor system facilitates the pickup and delivery of trays, while a gantry robotic arm moves the trays between the storage racks and the conveyor, optimizing storage and retrieval operations.
4. **Vacuum Gripper Robot**: A 3-degree-of-freedom (3DoF) robotic arm equipped with a vacuum gripper end effector, this robot enables the precise and automated manipulation of materials within the factory.

Each simulation model within the project is controlled by a Siemens SIMATIC S7-1215C DC/DC/DC PLC and monitored via a Siemens KTP700 SIMATIC HMI. PLC programming is done using Ladder Logic (LD) and Structured Control Language (SCL), ensuring reliable and efficient control over the automation processes. Communication between the PLCs is established using the PROFINET protocol, which supports high-speed data exchange and real-time control.

This project showcases the implementation of cutting-edge techniques in automation and intelligent manufacturing, aligning with the principles of Industry 4.0. It also paves the way for Industry 5.0 by emphasizing the collaboration between humans and machines, leading to more personalized and efficient manufacturing systems.

Preserving Egyptian and Arab Design Culture

The Egyptian Design Archive (EDA) is an innovative initiative developed by students to document and preserve the contemporary visual culture of the Arab world. Its mission is to inspire, connect, and educate emerging talents, academics, and professionals across the region while contributing to the global recognition and visibility of Arabic graphic design.

EDA operates through several platforms, each with a specific focus on different aspects of Arab visual language and design. One of these platforms is 100/100 Best Arabic Posters, which serves as a hub for research and publications, celebrating the diversity of Arabic visual expression through dynamic poster designs. This platform showcases the richness and evolution of Arab design, highlighting its cultural and artistic significance.

Another key platform is Say My Name, dedicated to the archival exploration of female Egyptian designers and artists. It aims to bring visibility to the contributions of women in the Egyptian design scene, celebrating their work and fostering greater recognition for female creators in the region.

Together, these platforms provide a comprehensive and evolving archive that documents the unique visual narratives of the Arab world.

Matter-Minds Architectural Project

The Matter-Minds architectural project is an initiative for eco-conscious design, centered around computational methods and material innovation. This project focuses on pushing the boundaries of material usage in architecture by introducing new, sustainable substances that haven't traditionally been applied in the field.

The development process is divided into three key stages. The first stage involves material experimentation, where unconventional, eco-friendly materials such as algae-based composites, mycelium, biodegradable bioplastics, wax, and crystallized salt are explored. These materials are selected for their potential to revolutionize architecture through sustainability and their adaptability to a variety of environments.

In the second phase, these experimental materials are transformed into architectural prototypes, showcasing their structural integrity and aesthetic possibilities in real-world applications. This prototyping process ensures that the materials are not only innovative but also practical for use in building designs.

The final phase leads to the creation of a biodegradable yoga shala located on the Nile River, inspired by the surrounding natural environment. This design phase emphasizes harmony with nature, ensuring that the structure can blend into its surroundings while minimizing environmental impact. The biodegradable nature of the project ensures a low ecological footprint, aligning with modern sustainable design principles.

The project focuses not only on the finished structure but also on documenting the experimental journey, providing a comprehensive look at the development of sustainable architectural solutions.

Self-Driving Car

The Self-Driving Car project integrates the fields of Engineering and Informatics to develop a fully autonomous vehicle, with a primary project focused on transforming a standard golf car into a self-driving machine. The vehicle relies on an array of sensors, including LiDAR, to gather and process large volumes of data from its surroundings. This data is then analyzed using advanced algorithms, machine learning, and deep learning techniques to enable accurate control and navigation without human input.

The lab is actively investigating a range of complex challenges that are critical to advancing autonomous vehicle technology. One of the key areas of research is **pedestrian behavior prediction**, which involves understanding and anticipating human movement in various environments. This is particularly challenging due to the unpredictability of human actions and varying traffic scenarios.

Another significant challenge being explored is **obstacle detection and avoidance**. The vehicle must be capable of identifying and responding to both static and dynamic obstacles in real time. This requires the development of highly sophisticated perception systems that can accurately interpret the vehicle's surroundings and make split-second decisions to ensure safety.

In addition, a unique challenge being addressed is **adapting autonomous vehicles to Egypt's road conditions**. Egypt's roads often feature irregular traffic patterns, including inconsistent lane markings, variable road quality, frequent pedestrian crossings, and the presence of informal street vendors. These factors make navigation and obstacle detection more difficult compared to highly structured environments, requiring more flexible and adaptive systems that can handle unpredictable scenarios.

Additional challenges include **sensor fusion**, which involves integrating data from multiple sensors (LiDAR, cameras, radar) to create a comprehensive view of the environment.

This requires managing large data streams and synchronizing them in a way that allows the vehicle to make reliable decisions. **Weather adaptability** is another hurdle, as sensors may not perform optimally under adverse conditions like dust, fog, or rain, making reliable navigation more complex.

In this project, the multidisciplinary approach, blending mechanical engineering with computer science, is crucial in addressing these challenges. By tackling these issues, the project aims to develop smarter, more efficient, and safer autonomous transportation solutions tailored to both global and local contexts. The project showcases the ongoing research efforts to overcome the intricate technical barriers of autonomous driving, bringing the vision of self-driving vehicles closer to reality, even in challenging environments like Egypt.

Jewelry Collection: VOLUMETRIC EXPLORATION

The aim of the project was to create a three-dimensional representation of volume using a series of planes, employing at least three distinct volumetric explorations, with due consideration given to the resolution of the shape and the definition of a structural framework and principal axis. The students explored a wide range of jewelry creation and design methods, from the initial conceptualization of ideas through every stage of manufacturing, culminating in the professional presentation of their final products. This comprehensive approach covered both theoretical foundations and practical skills, with students learning various manual techniques in the jewelry design workshop, including the use of tools and machines for metalsmithing. They also experimented with advanced technologies such as laser engraving and chemical processes to manipulate and work with different materials.

Sustainability was also a key theme in the workshop. Students explored the use of sustainable materials, incorporating bioplastics into their creations. This focus on environmental awareness combined with jewelry manufacturing led to innovative designs that bridged aesthetics and sustainability.

From a design and cultural perspective, jewelry projects drew inspiration from Egyptian Heritage, Japanese Notan art, and other notable cultural influences.