Mi5 Showcase

The Mi5 Showcase is a highly modular, cross-linked pro-
duction system which can make customized products
of solids and liquids. It was built to show what Industrie
4.0 can look like, what it means, and how to enable
faster integration of new modules.

Project goals:

- **Industrie 4.0 Easily Grasped:** Illustration of comp-
  lexity and interdependencies in the Industrie 4.0
  environment using a practical project example
- **Prototype Development:** Implementation of a
  modular production plant for sandwich cookies and
  cocktails as a vivid demonstration at fairs
- **Practically Relevant Training:** Interdisciplinary project
  work in cooperation with industrial partners
- **Tool-Based Systems Engineering:** Application of agile
  mechatronical development methods, such as Scrum,
  and tool-based engineering, e.g. PLM (Siemens) or
  simulation (industrialPhysics)
- **Expandable System:** The demonstrator was
  engineered considering the highest possible flexibility
  for new modules e.g chocolate printer, change unit
- **Supplier-Independent design:** Using control units
  from various companies, e.g. Beckhoff, B&R, Siemens,
  etc., the demonstrator is also a showcase of the high
  compatibility of an OPC-UA connection

Upcoming Projects:

- **Agency-Based Communication:** Decentralized
  production control and Service-oriented
  Architecture (SoA) to enable runtime modifications
- **Change Unit:** New module to change product
  carriers to expand the systems flexibility
- **Coffee Module:** Increase the number of available
  products by providing different sorts of coffee

Mi5 Teams

An interdisciplinary and international team of now 100
highly motivated students from a variety of fields and
nations (Italy, Spain, Tunisia, China) implemented the
„Mi5 Showcase" project together with partners from
industry, research and education.

About ITQ GmbH

ITQ GmbH consults and supports during all phases of
software development, allowing for special mechatro-
nic problems in mechanical engineering. The core com-
petencies, besides software engineering (comprising
analysis, design, implementation, and test), are process
improvement, project management, and crisis manage-
ment as well as consulting and coaching. One particular
focus of the company is suitable and forward-looking
training concepts. For that reason, the company fosters
young academics in practice-oriented assignments
such as the Mi5 project.

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ITQ
competence in mechatronics
software and systems engineering

Industrie 4.0 Mi5 Showcase

**innovative** education

The Project:

- Development of a modular production system as a graphic demonstrator in an Industrie 4.0 context
- Production of solid, viscous and fluid materials like sandwich cookies and cocktails
- Demonstration of ideal engineering and development methodology using practical examples
- Interdisciplinary development and project management in an international student team

CloudLink and web services

- Service-oriented Architecture (SoA)
- Well-defined and secure REST API
- Connection of the machine interface with CloudLink as a web service
- Future-oriented architecture using node.js

Simulation & virtual commissioning

- Simulation of sensors and actuators
- Validation of interaction & communication
- Test of process flow and malfunctions
- Parallel development of hardware & software
- Iterative approach by simulated prototypes
- Complete „digital copy" of the system
- Use of **Machineering industrialPhysics**
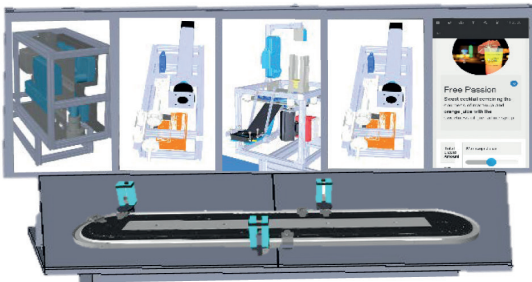
HMI & mobile user interface

- HTML5, JavaScript, Socket.io, JADE
- Integration of innovative web technology
- Implementation of mobile user interfaces
- Operator integration by feedback
- OPC-UA-client-based live website
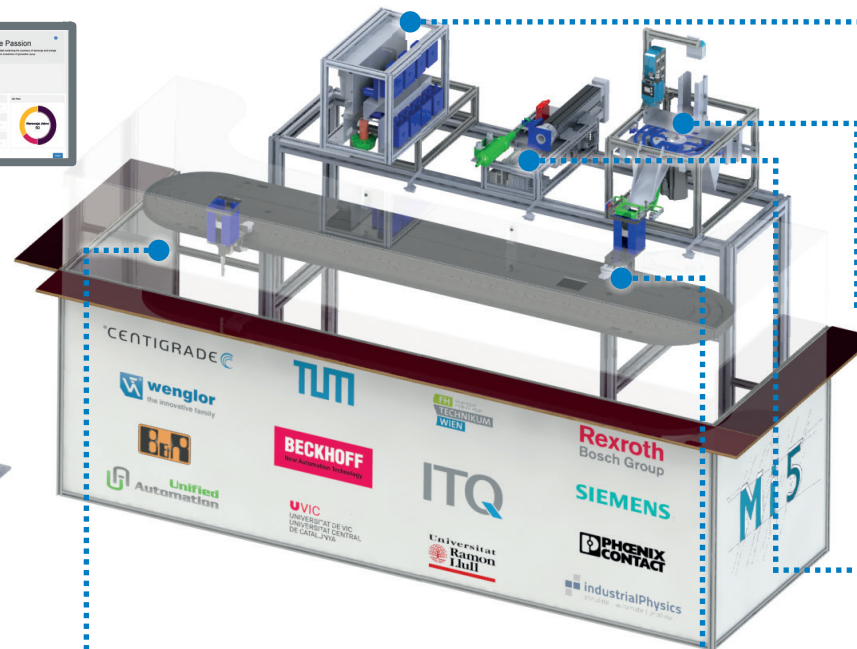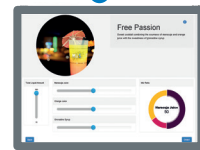
Development methodology

- Integrated mechatronical development
- Intersection of classic and agile methods
- System specification and information networking
- Systems Engineering: Functional development
- Use of tools and evaluation with **Siemens PLM**

Module: Cocktail dispenser

- Dosing of fluid ingredients via 8 hose pumps
- **B&R SPS Controller**

Module: Cookie individualizer

- Storage, separation and screening of cookies
- **Beckhoff PLC & Drive**

Module: Topping dispenser

- Application of viscous materials for the cookie sandwich
- **Beckhoff/Bosch Rexroth (SPS)**
- **Bosch Rexroth (Drive)**

Modularity & Communication

- Functional „skill" abstraction, module encapsulation
- Automatic reconfiguration on changes
- Process steps are dynamically assigned to individual modules on the spot
- Standardized platform-independent module interface

Module: Transport system

- Circle-route magnetic linear drive
- Individual control of movers
- Second degree of freedom by paired coupling
- Dynamic path planning and collision recognition
- Accuracy < 10 μm, speed up to 4 m/s
- Beckhoff XTS (eXtended Transport System)