Safe and Trusted Human Centric Artificial Intelligence in Future Manufacturing Lines

STAR

Enabling SAFE, SECURE and ETHICAL AI in Manufacturing

STAR researches, develops, validates, and makes available to the community leading edge AI technologies with wide applicability in manufacturing environments:

Explainable AI

Why did you do this?

- Explain to Factory Workers and Quality Engineers the rules and principles of the AI systems operation

- Increasing Transparency and Trust on AI Systems

Active Learning

Robot-to-Human: Is this piece defected?

- Query human where not sure what to do next!
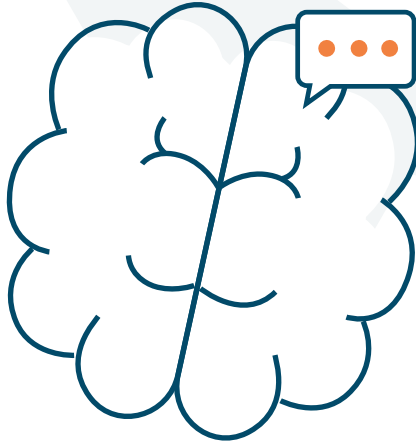
- Accelerate Knowledge Acquisition for AI

(Cyber) Security for AI Systems

Protection of AI Systems against Adversarial Attacks

STAR

Human-Centric Digital Twins

What-if-Analysis with the Human-in-Loop?

- Simulation & Detection of Safety Issues
- Optimal Deployment of Automated Mobile Robots
- Detection of Safety Zones

Simulated Reality

Shorten Reinforcement Learning Cycle

- Simulate the next actions of Reinforcement Learning than expecting convergence

These technologies are validated in challenging scenarios in manufacturing lines, in the areas of quality management, human robot collaboration and AI-based agile manufacturing

Safe and Trusted Human-Centric Artificial Intelligence in Future Manufacturing Lines

The challenge

Artificial intelligence (AI) systems in the manufacturing sector are increasingly replacing human tasks improving the automation of production. These systems need to be safe, trusted and secure, even when operating in dynamic, unstructured and unpredictable environments to be able to react to different situations and security threats. Ensuring the safety and reliability of these systems is a key prerequisite for deploying them at scale and for fully leveraging the benefits of AI in manufacturing.

Challenges for AI in Industrial Systems:

- Transparency and Explainability

- Slow and Hazardous Interactions between AI Systems and Manufacturing Environment

- Human-Centric AI Systems i.e. AI, Humans, Robots must co-exist in Industrial Plants

- New Opportunities for AI (Cyber)Security Attacks

- Inaccuracy and Unreliability of Industrial Data

Discover STAR

STAR, a joint effort of AI and digital manufacturing experts, deploys standard-based secure, safe, reliable and trusted human-centric AI systems.

STAR researches, develops, validates and makes available to the AI and Industry 4.0 communities novel technologies that enable AI systems to acquire knowledge in order to take timely and safe decisions in dynamic and unpredictable environments, including: Explainable AI, Active Learning and Simulated Reality for fast, safe and efficient online learning and knowledge acquisition, Human-Centric Digital Twins, and Security for AI systems.

These technologies are validated in challenging scenarios in manufacturing lines, in the areas of quality management, human-robot collaboration and AI-based agile manufacturing.

The project's results are fully integrated into existing EU-wide Industry 4.0 and AI initiatives (notably EFFRA and AI4EU), as a means of enabling researchers and the European industry to deploy and fully leverage advanced AI solutions in manufacturing lines.

Use Cases

Human-Robot Collaboration
Human-Cobot Collaboration for Robust Quality Inspections
PHILIPS – Drachten, Netherlands

Secure AI
Human-Centred Artificial Intelligence for Agile Manufacturing 4.0
IBER – OLEFF – Portugal

Safety with AI
Human Behaviour Prediction and Safe Zone Detection for Routing
DFKI – SmartFactory-KL lab - Germany

Impact

- Increased intelligence & flexibility in production lines
- Safe human-robot collaboration at scale
- Faster uptake of AI solutions (Quality 4.0, Cobots)
- Ethical impact in manufacturing in line with HLEG recommendations
- Research (e.g. Simulated Reality, Active Learning, Explainable AI) placing EU at the forefront of global AI R&D
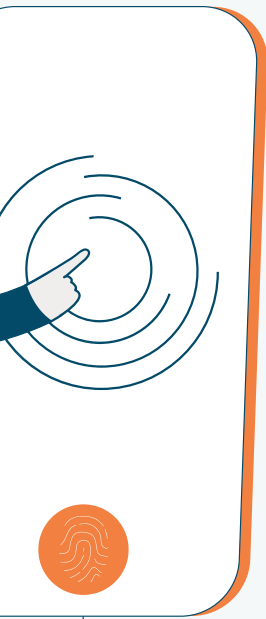
STAR Technologies

The STAR project is developing a number of technologies for trusted AI solutions that address different domains such as Cyber Security, Human-Robot collaboration, and Safety. These assets, resulting from continuous research, development, and validation, are crucial enablers of security and safety in production lines.

STAR components support authentication procedures, querying, browsing, accessing, and modifying data, orchestrating data flow, and can be leveraged to find holistic solutions that can increase the overall trustworthiness of several production systems.

Distributed Ledger Services for Data Reliability (DLSDR): A trusted decentralised solution for industrial data provenance and traceability covering tracking and tracing of raw data, AI models/algorithms and AI analytics.

Runtime Monitoring System (RMS): RMS provides a real time service which collects security related data from monitored IoT system components or applications. RMS enables appropriate filtering and data transformation mechanisms for reporting irregular measurements, that might be related to an attack/abuse case, and are used to drive the STAR Security Policy Manager.

AI Cyber-Defense Strategies (ACDS): AI Cyber defense tool for the protection of manufacturing AI data pipelines against poisoning and evasion attacks.

Risk Assessment and Mitigation Engine (RAME): Risk assessment and Mitigation Engine for the management of the lifecycle security incidents and risk indicators in manufacturing environments.

Security Policies Manager (SPM) - Security Policies Repository (SPR): The Security Policy Manager is a multipurpose tool for defining a system of rules for automatically identifying cyber threats. The rule definition is specific to the application domain and the type of data available (e.g., GPS, CPU consumption, logs). Additionally, the Security Policy Manager is agnostic to the data source, allowing the definition of policies for both hardware and software components.

XAI Models and Library: A set of techniques that help develop more explainable models while at the same time preserving their high-performing learning functionalities in real-world manufacturing environments and applications.

Simulated Reality (SR): Synthetic data generation and intelligent oversampling methods. This can be used to improve the performance of machine learning models, when little data exists or when skewed distributions are found.

Active Learning (AL): Algorithms that enable finding most informative data samples from unlabelled data, which allow to increase the learning of machine learning models while minimising the labelling effort.

Production Processes Knowledge Base (PPKB): Prototype knowledge-graph encoding information regarding users' perception of anomaly and heat maps showing either potential defects or where a machine learning algorithm focuses (pays attention to in the image) to determine whether a defect exists.

Multimodal Worker Training Platform: Web service that combines Natural Language Processing and Workers Training Platforms to offer a solution that allows operators to learn more about their occupation, detect knowledge gaps and get training recommendations. All offered through chatbots and multimodal interfaces.

Feedback Module: Prototype for feedback service implemented for a demand forecasting and logistics planning proof of concept.

AMR Safety: Solution for automated visual analysis and robots deployed in next generation work floor, using a computer vision module detecting empty areas merged with a dynamic robot path planning engine for secure robot displacements.

Human-Centred Digital Twin: The Human Digital Twin Core Infrastructure is an extensible and flexible IIoT - industrial internet of things - based platform supporting the creation of customised data representations of production systems and their entities, including humans.

Fatigue Monitoring System: The Fatigue Monitoring System uses artificial intelligence (AI) models relying on machine learning to estimate the exertion level of subjects based on static data (e.g. age, weight, etc.) and dynamic data (e.g. HR, EDA, skin temperature).

Workers Activity Recognition: The Workers Activity Recognition Module recognises worker's activities by using time-series sensor data from wearable sensors including accelerometer, gyroscope, magnetometer, and capacitive sensors to optimise the interaction between humans and mobile robots and prevent collisions.

MARKET PLATFORM
by STAR

Discover a broad range of information about trusted AI solutions in Manufacturing at MARKET by STAR!

Assets

The catalogue of assets that support the implementation of trusted AI Solutions in production line, addressing different dimensions and elements of trust, security and safety in the operation of Cyber Physical Production Systems (CPPS)

Success Stories

The experiences in real-world scenarios of three STAR Pilots sites focused on different areas of production and research

Training Resources

Courses, workshops and other training resources with the latest information about the work developed in the AI domain

External AI Resources

A universe of AI Solutions from external sources

The STAR Book

Open Access Book on Trusted Artificial Intelligence for Manufacturing (over 40.000 downloads)

Visit our website: www.star-ai.eu
Contact us: info@star-ai.eu Project coordinator: Netcompany-Intrasoft
Follow us: 🐦 @starAI_eu 🔗 Star EU Project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 956573

netcompany intrasoft · UBITECH ubiquitous solutions · PHILIPS · UNIVERSITY OF PIRAEUS RESEARCH CENTER · UNPARALLEL · ARTHUR'S LEGAL Challenge the Status Quo · R2M SOLUTION · GFT

SUPSI University of Applied Sciences and Arts of Southern Switzerland · DFKI · IBER-OLEFF · THALES · Jožef Stefan Institute · university of groningen · SIEMENS