

FLUENTLY

THE ESSENCE OF HUMAN ROBOT INTERACTION

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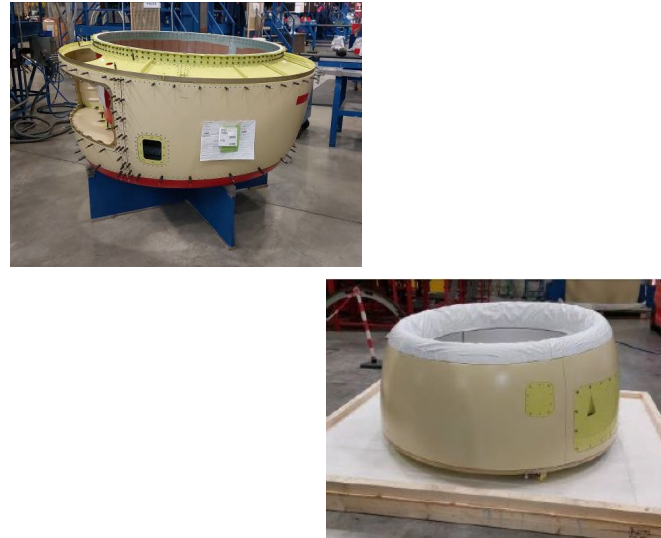
USE CASES AND INDUSTRIAL CHALLENGES

Dismantling and Recycling of Lithium Cell Battery E-bike Packs



- Fully manual
- Extremely high variability of product assembly
- High dexterity
- Exposure to toxic materials
- Risk of explosion

Flexible Assembly of Aircraft Engine Nacelle



- Highly manual
- Highly iterative assembly, positioning and fixing tasks
- Wide dimensional and weight variability
- In-process and final inspection quality checks based on human operator experience

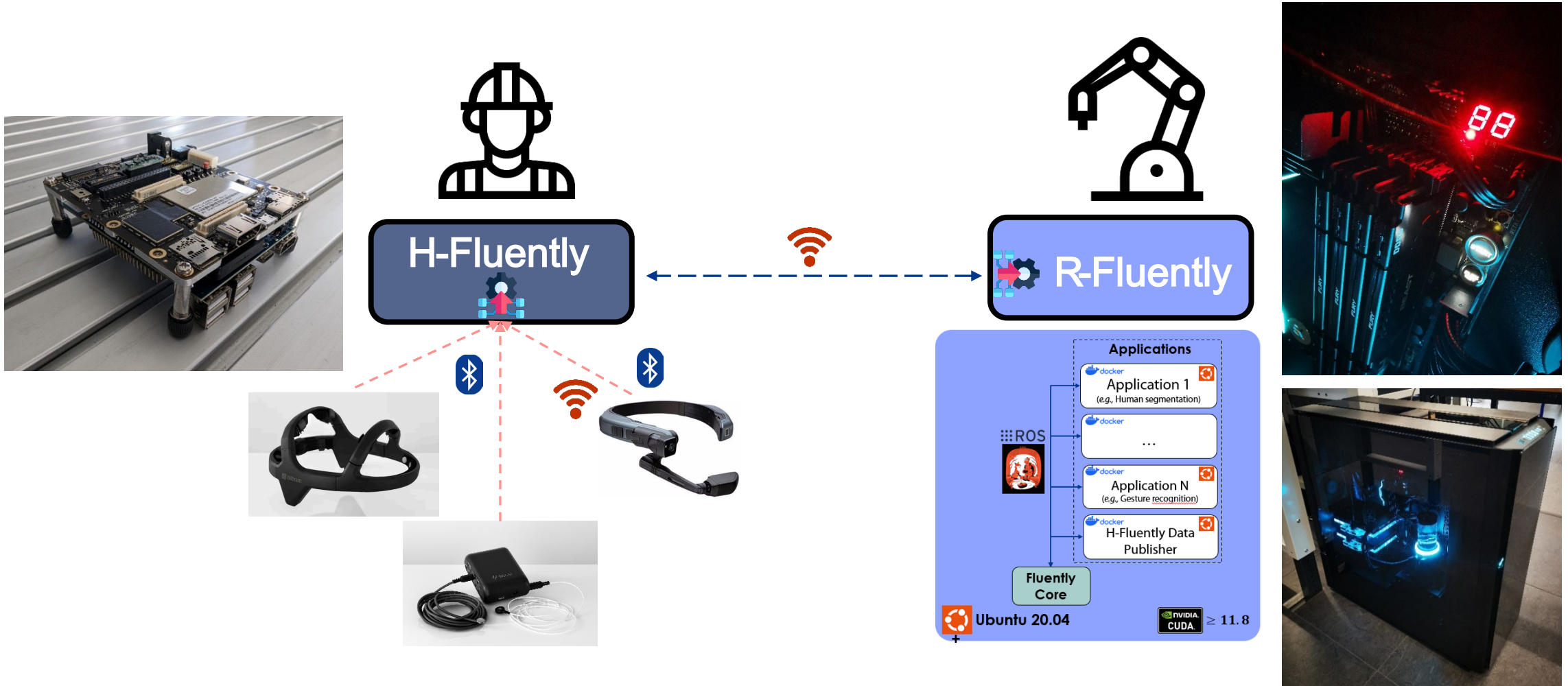
Hybrid Manufacturing of complex metal components



- Fully automated (equipment)
- Complex part shapes
- Diversified defects
- Fully customized process chain
- Extended programming time
- Inspection and repairing strategies highly dependent on human operator's experience

OBJECTIVE #1 FLUENTLY SMART AI POWERED INTERFACE UNIT

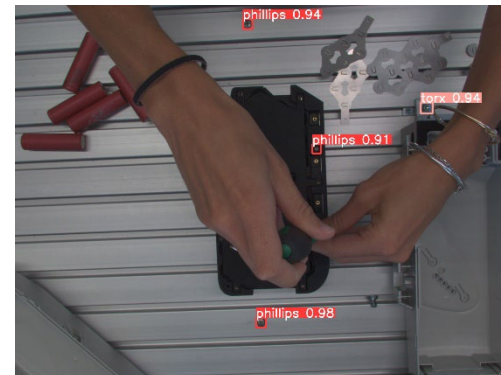
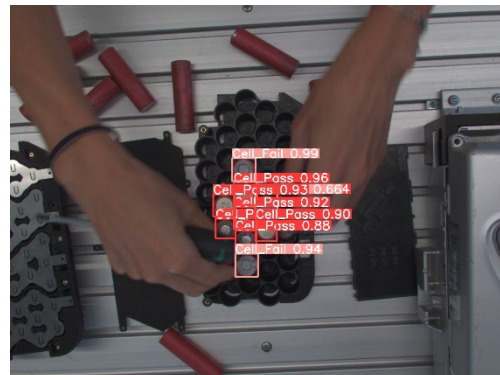
Distributed Processing Architecture



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OBJECTIVE #2: FLUENTLY ROBOGYM

Training Infrastructure and Experience



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ENABLING TECHNOLOGIES

AI and ML methods

- Natural Language Processing
- Semantic Segmentation
- Object Recognition
- Hand Pose and hand-object interaction
- Body Posture Recognition
- Multi-modal mental state
- Activity Recognition
- AR/VR

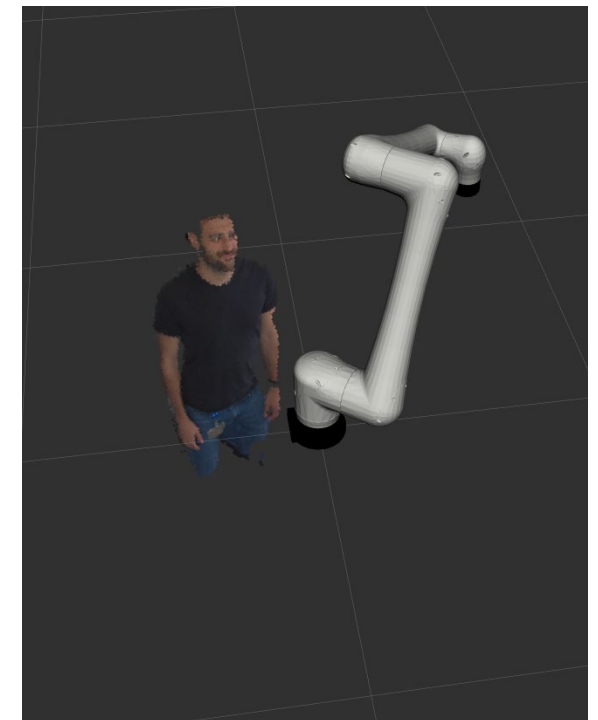
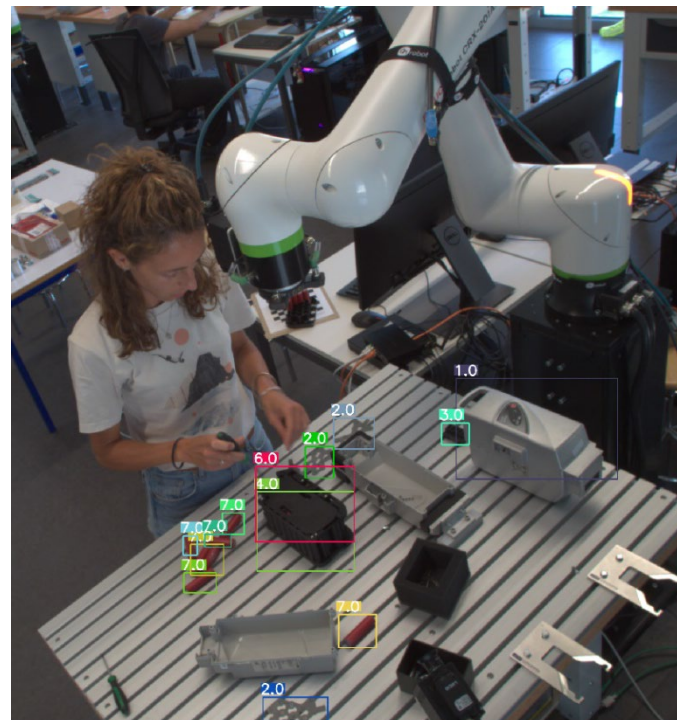
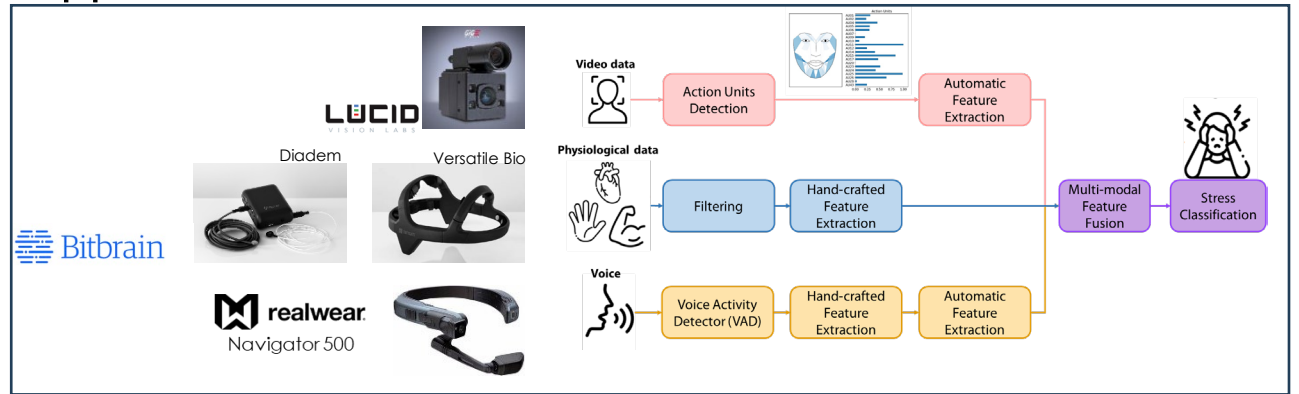
Centralized and Distributed Intelligence

- Wearable sensors
- Edge and cloud computing

AE and Ethical Manufacturing

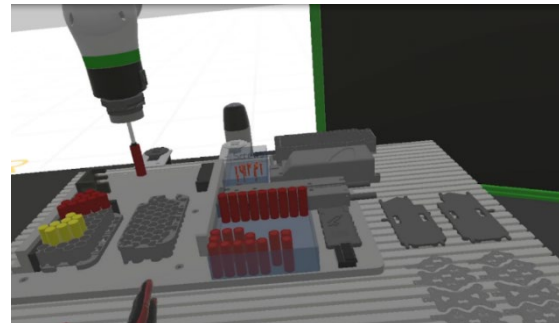
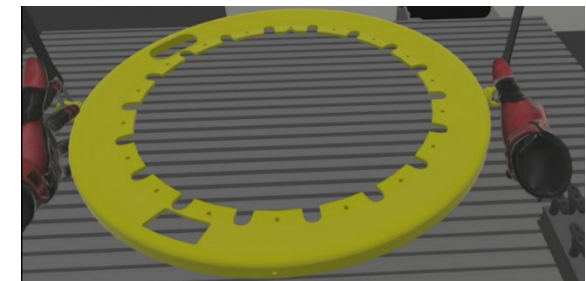
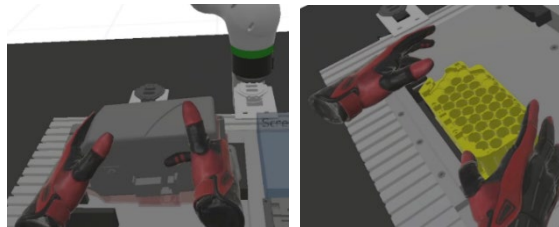
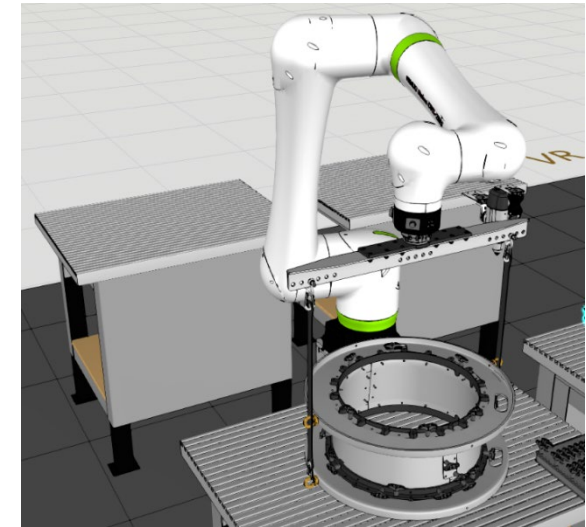
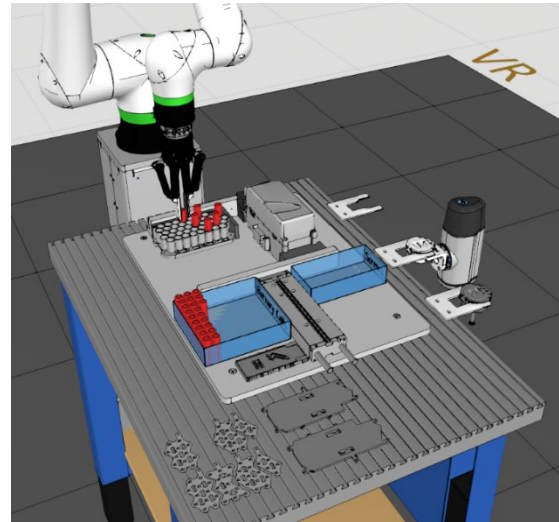
- AI-assisted decision making
- Human behavioral model
- Mapping to current cognitive/physical status
- Diversities management

AI pipeline for Multi-modal mental state assessment



THE ROBO GYM EXPERIENCE

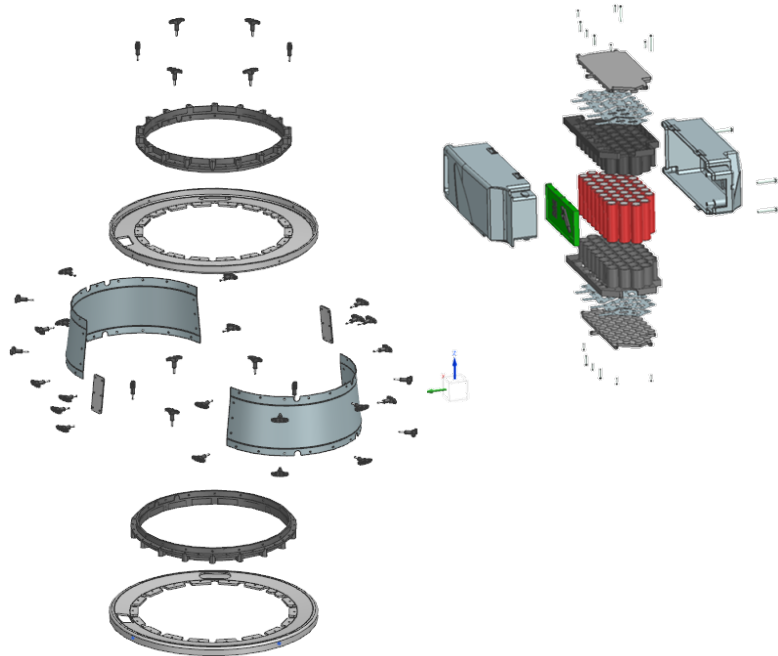
Acquaintance area	
Operator Learning skills	<ul style="list-style-type: none"> • Fluently control and functions initialization • Interact with cobots in virtual environment • Avoiding incidents in emergency situation
Fluently Learning skills	<ul style="list-style-type: none"> • User tone and vocabulary • User emotional state in dangerous situation • Procedure and user decisions in collaboration with cobots



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THE ROBOGYM EXPERIENCE

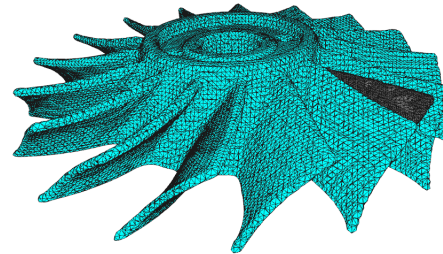
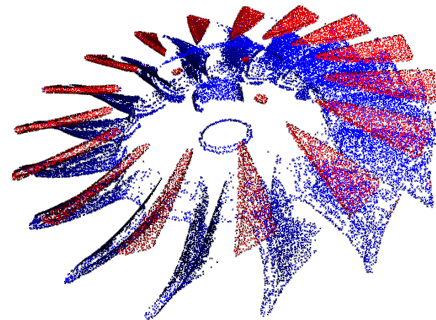
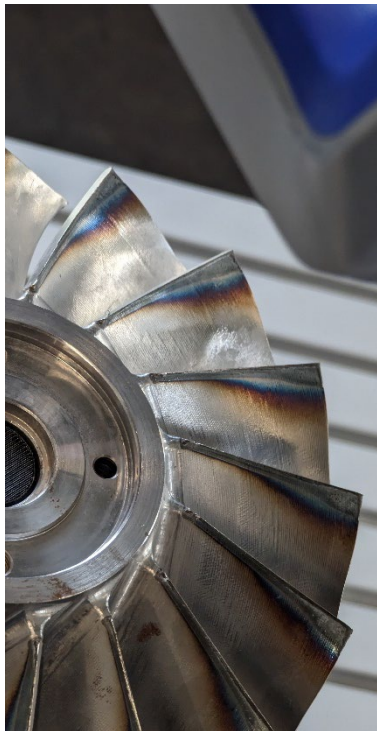
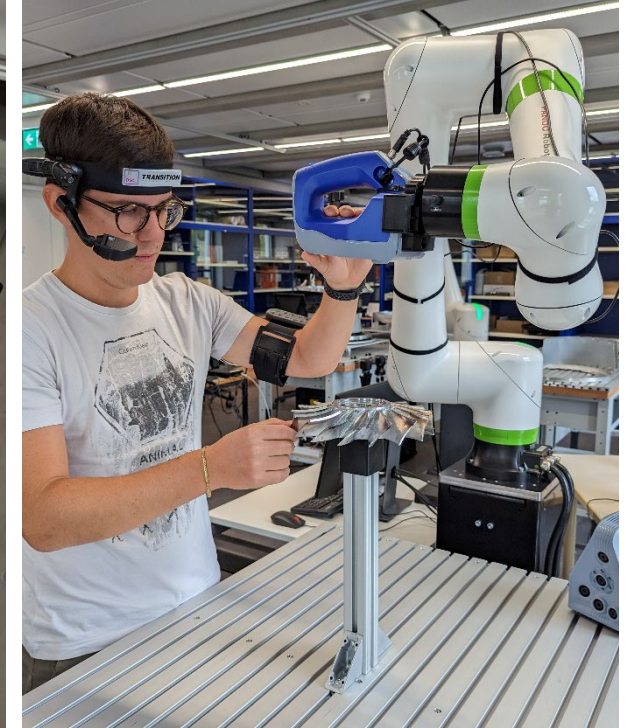
Dexterity area	
Operator Learning skills	<ul style="list-style-type: none">• Control and send commands to cobots• Use Fluently for specific object recognition and handling application• Define robot tool path for manufacturing tasks
Fluently Learning skills	<ul style="list-style-type: none">• Association of tools to user application• Adapt robot dynamics to user task• Optimal cobot posture for object recognition and scanning



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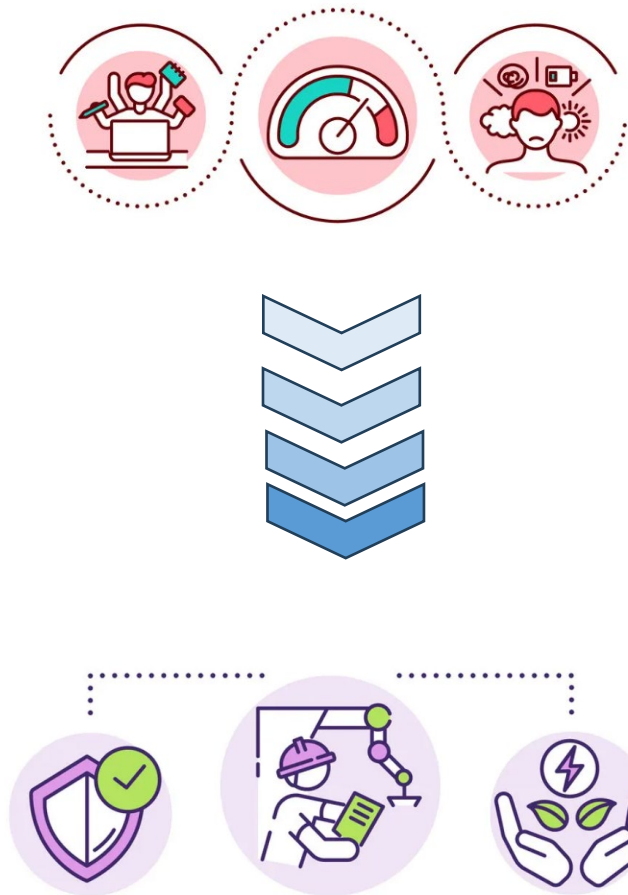
THEROBOGYM EXPERIENCE

Application area	
Operator Learning skills	<ul style="list-style-type: none"> Control and interact with Fluently in complex tasks Modify the activities and process parameters while running tasks
Fluently Learning skills	<ul style="list-style-type: none"> Associate process parameters and tool to operations Predict sequences and operation to specific components



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FLUENTLY CONTRIBUTION TO EU INNOVATIVE MANUFACTURING ECOSYST



- **Human-robot collaboration enabled by natural commands**, like voice (i.e., speech to command), gestures or implicit cues
- **Smart AI wearable powered unit** enabling frictionless human robot communication with **generative models capable of inferring missing or incomplete sensor modalities** in real production contexts
- **Immersive and interactive training ecosystem** for the **mutual and continuous building of knowledge and skills** of both human and robot
- **Robot's behaviour adaptation** based on the very **specific personality and working style** of the human in dynamic manufacturing contexts

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CONSORTIUM



+ CIM4.0



SUPSI



Politecnico di Torino



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THANKYOU

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