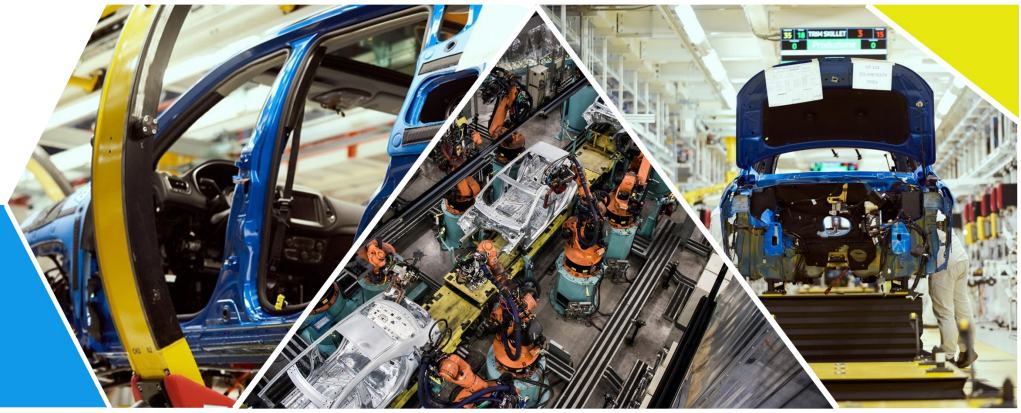
FELICE

NEWSLETTER Nb.2



Project Progress

Currently, the consortium is working towards milestone 3 in June 2022 in the first phase of the project. The project has made progress in all work packages towards the project objective in the following tasks:

- WP3: Security and privacy enabling mechanisms, scene perception and knowledge base, as well as the visualizations for the User
- WP4: Object detection and localization and scene perception, human parameters and modelling and gesture analysis
- WP5: robot and adaptive workstation for manual assembly, Task execution and verification, cognition for human-robot team fluency
- WP6: Modelling and Digital Twin of the production process, Quality assurance in Digital Twin modeling, Feedback strategy management
- WP7: Ergonomics and productivity data analytics, resilient assembly line, Intelligent manufacturing execution system
- WP8: Demonstrations according to the integration strategy for system integration and deployment in phase 1 are planned
- WP9: Plans for Dissemination, communication- and exploitations activities have been worked on and carried out

Meetings

Bimonthly technical meetings have been held to coordinate the progress across the work packages.

Meetings coordinating the Integration and Demonstrations of Phase 1

See also pages 3 and 4

Amendment

The project duration was changed to September 2024 due to technical problems related to hardware procurement for prototypes

All future deliverable deadlines will be shifted by 3 months

Technologies

Next to systemic and informatic innovations, there are also hardware solutions developed in the FELICE project. Here we present the hardware development progress carried out in work package 5 for phase 1 of the project.

FELICE Adaptive Workstation

The FELICE adaptive workstation (AWS) is developed as a platform for the ergonomic manual assembly of large work objects and will be deployed in the car door assembly use case at the CRF facilities in Melfi. In the first phase of the project, the station will adapt the position (height and inclination) of the work object during the assembly process to make ergonomic working postures possible. The target position is hereby based on the operator's anthropometry (measurements of the human body and body parts) and biomechanical principles (effects on the human musculoskeletal system).

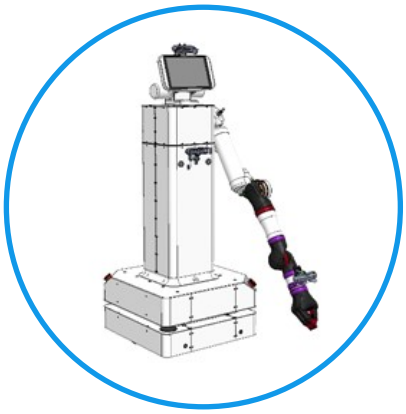
This use case proves challenging, as a total of 36 operations are conducted over the entire 1 m by 1.2 m car door frame, thus a single ideal ergonomic position does not exist. Instead, a repositioning of the work object will be instructed by the orchestrator at key moments of the process. Alternatively, the user will be able to manually adjust the system using buttons or by issuing voice commands.

In the future, cognitive support using screens and audio devices, as well as adaptation of environmental parameters (light intensity) are planned.

Click here for a video of the prototype

FELICE Robot

The mobile FELICE Robot will collaborate with the worker and will provide support in the FELICE system. It is able to navigate on the shop floor to cover multiple workstations according to a decision-making algorithm.



Its Hardware consist of the mobile robotic platform, an elevating mechanism, and a 6 DoF arm. To enable the robot to communicate with the worker using different modalities the Robot Head is equipped with a microphone, to register voice commands, a touch display and a camera.

Currently, the consortium works on the Task execution, especially on the identification and grasping of objects, as well as the robot task planner, which will let the robot act based on the current workflow set by the orchestrator.

The robot modules will be used in both use cases, the small part assembly at the lab at the University of Applied Sciences Upper Austria (FHOOE) and the car door assembly use case at the CRF Lab in Melfi.

Click here for a video of the prototype

Use cases

Phase 1 of the FELICE project includes the integration of the developed technologies and solutions in two use cases to evaluate the orchestration, optimisation and interfacing of the FELICE system modules.

The Centro Ricerche FIAT (CRF) use-case scenario concerns an almost real production environment, specifically a vehicle door assembly line with seven workstations.

The performance of the composite system will be tested and demonstrated starting from the indicative scenarios: workshift initialisation, normal workflow and deviations in the workflow (see below).

The use-case scenario of the University of Applied Sciences Upper Austria (FHOÖ) refers to a small-scale prototyping facility featuring a flexible demonstrator of a manufacturing system.

Experiments in the prototyping environment will be used to validate the AI-based assembly orchestration and demonstrate its effectiveness in comparison to non-AI reference workflows. Testing Scenarios include the assembly of small industrial PCs.

Scenarios

Three scenarios for the Centro Ricerche FIAT (CRF) use case are showcased in the pilot production environment of CRF:

Scenario 1: Workshift initialization	During the initial setup of the work shift the Orchestrator determines the distribution of the assembly tasks among the human workers. The robot is instructed to work on a particular workstation (WS) or adaptive workstation (AWS) and navigates to and from it using its onboard sensors. The configuration of the AWS is adapted to the individual worker characteristics.
Scenario 2: Normal Workflow	The assembly process starts and the Orchestrator continuously monitors its operation. The configuration parameters of the AWS are adjusted to compensate for progressive changes in human behaviour. The robot navigates among different WS to assist workers by providing assembly items on request.
Scenario 3: Workflow deviations	The system detects deviations from the designed normal workflow and hence the Orchestrator instructs the robot to navigate to a different WS to support the worker assigned to it or decides whether a worker needs a break. The AWS informs the worker about the arrival/departure of the robot. The robot navigates to the WS it is instructed to support.

Demonstrations

These demonstrations are used to test and evaluate the interoperability, orchestration and interfacing of the individual components and the FELICE system within the defined Use cases in phase 1:

1. System initialisation

All components are up and running. AN Initial decision from the orchestrator is made to direct the robot to a specific WS. The height of the AWS is adapted to the individual worker‘s needs.

2. Human ergonomic analysis

Workers‘ body postures are continuously estimated during the shift and evaluated concerning ergonomics. The body postures are evaluated, visualized and assessed. An aggregated ergonomic anaylsis for an entire cycle is set up and posture alerts and ergonomic indicators are communicated.

3. AWS in action

The Assembly line is operating with the adjustments provided by the adaptive workstation. The workstation adapts its height according to voice commands, manual inputs or the orchestrator’s instructions. The relevant information to the worker are displayed

4. Robot navigation

The Robot moves to a specific location on the shop floor. Messages requesting robot platform movement are received and the robot moves to the specified location.

5. Object Pick up

The robot platform is assumed to be in the vicinity of an object to be picked up. The object is localized, the arm moves near it, the gripper grasps it, and the arm picks it up.

6. Digital assembly view

The system manager starts the simulation model of the assembly line. The orchestrator interacts with the running model and proposes certain decisions. The simulation model carries out those decisions if not intervened by the user.

7. Robot in action

The robot collaborates with workers at different WSs by handing them tools/parts, accounting for variability in the workers (height, left/right-handed) and objects.

Publications

Recent scientific publications

Akkaladevi S.C. et al. (2021) Programming-Free Approaches for Human–Robot Collaboration in Assembly Tasks. In: Wang L., Wang X.V., Váncza J., Kemény Z. (eds) Advanced Human-Robot Collaboration in Manufacturing. Springer, Cham.
DOI: https://doi.org/10.1007/978-3-030-69178-3_12
Link: https://link.springer.com/chapter/10.1007%2F978-3-030-69178-3_12

M. Lourakis and G. Terzakis, (2021) "A Globally Optimal Method for the PnP Problem with MRP Rotation Parameterization," 2020 25th International Conference on Pattern Recognition (ICPR)
DOI: https://doi.org/10.1109/ICPR48806.2021.9412405
Link: https://ieeexplore.ieee.org/document/9412405

Conference contributions

FELICE special session at International Conference on Industry 4.0 and Smart Manufacturing (ISM 2021)

18th International Multidisciplinary Modelling & Simulation Multiconference (I3M 2021)

European Robotics Forum: Workshop on Human-Robot Collaboration & AI for Sustainable Production (ERF 2021)

Deliverables

Public FELICE deliverables released under the work plan are accessible on our website
Click here for more information

WP1—Project coordination and management:
D1.2: Data management plan
D1.4: Innovation management plan

WP3—System baseline technologies and enablers:
D3.1: State of the art report

WP9—Dissemination, exploitation and long-term sustainability:
D9.1: Project website and visual identity
D9.2: Dissemination and exploitation plan

SCAN ME

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https://www.linkedin.com/company/h2020feliceproject/

https://bit.ly/3tNA3c5

https://www.felice-project.eu/

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