MARI4YARD
MARI4ALLIANCE

Grant agreement nº: 101006798

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Deliverable D1.7

Portfolio of Mari4_YARD worker-centric tools

Work Package 1

Specification and vertical integration

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DOCUMENT HISTORY

Version	Date	Changes	Stage	Distribution
0.1	16/03/2023	Document started, comments, sections and subsections.	Draft	AIMEN
0.2	29/05/2023	Elaboration of Catalogue of solutions.	Draft	AIMEN
1.0	28/07/2023	Catalogue of solutions referred and Annexed.	Final	ALL
2.0	07/08/2023	Minor changes (typos and wording)	Final	EC

EXECUTIVE SUMMARY

Mari4_YARD project proposes in addition to the development of the technologies, an incremental validation procedure based on a series of test sprints to test the performance of all the developed solutions. This series of test sprints provides flawless runs and sustainable results. Initial tests were focused on the evaluation of hardware, second test sprint on the operation of the first integrated versions of technologies and the last one, on the evaluation of the portfolio of solutions developed.

This deliverable aims to showcase the portfolio of solutions developed along the first 30 months of the project. Worker-centric tools in naval technologies with technical features and specific applications, targeting industrial stakeholders with non-technical knowledge. The deliverable is a catalogue of worker-centric tool brochures, presenting technological components, applications, and impact. The target audience includes SME stakeholders in the European Union, and the project will be disseminated digitally and in physical format at training sessions, workshops and congresses.

TABLE OF CONTENTS

1 INTRODUCTION

The primary goal of this deliverable is to showcase the Mari4_YARD compilation of essential technological components in two main aspects: technical features and specific applications in the naval sector. This deliverable serves as a visual representation of individual worker-centric tools, their technical specifications and target applications, demonstrating their ability to solve problems, create innovative solutions and adapt to new applications. The deliverable is presented in both digital and physical formats, comprising a catalogue of worker-centric tool brochures, providing a comprehensive overview of the project's technological capabilities and potential value to the stakeholder.

The target audience for this deliverable consists of industrial stakeholders with non-technical knowledge. Careful attention is given to defining terminologies and designing the catalogue visually appealing, with technological images and videos to attract the audience's interest. Each worker-centric tool includes a dedicated section on applications and impact, highlighting the potential benefits of the proposed solution.

The target platform for digitally disseminating this deliverable will be our website, social media (LinkedIn, Twitter), and the mailing list of the project. The physical format will be disseminated at the training session, technical workshops, and congresses.

The deliverable is presented as a catalogue of worker-centric tool brochures [ANNEX]. The catalogue is structured in six main sections: Cover, Project Overview, Technological Blocks, Worker-Centric Tools, Conclusions, and Closing. The cover page features the project logo and a visually appealing image. The project overview provides a bird's eye view of the Mari4_YARD project, followed by the portfolio description and the project's objective.

This is followed by the Technological Block section, which briefly outlines the four project technologies. These technologies are further elaborated in terms of the worker-centric tools. Such tools are explained by mentioning the involved partners, summarizing their scope, technical features, and associated applications and their impact. Finally, the conclusions and closing sections include contact information.

The main expected results of this deliverable include the improvement in the reach of the Mari4_YARD project to a wider audience, increased visibility on social media and among the main stakeholders at the European level, establishment of at least one contact in each of the major naval small and medium-sized companies across Europe, and the adaptation and adoption of the technologies presented in this deliverable beyond the applications mentioned.

A more detailed overview of the catalogue with the template, sections, sub-sections, word count, and layouts is presented in the next section.

2 Portfolio of Tools

The main objectives of this deliverable can be summarised in a twofold approach: dissemination purposes and contacts with stakeholders. For this reason, the core of this deliverable is the elaboration of a "Catalogue of Solutions".

- Project dissemination. The catalogue of solution elaborated in this deliverable will be publicly available through project outreach channels, appearing in the project website, Catalogue of the Mari4_YARD solutions - Mari4_YARD (mari4yard.eu),and social media. Posts in project and partners' social networks and communities will be published after the official submission, to enhance the impact and the dissemination, targeting to reach a broader audience. Physical and digital format will be available in the events where the project will be represented (conference, congresses, workshops, etc.).

- Generating interest and attracting attention of shipyards, auxiliary companies, SMEs and, in general, industrial organizations connected to the sector, potentially interested in the Mari4_YARD technologies.

3 Catalogue Structure

The user-centric tool brochures of Mari4_YARD are bundled into one catalog. The catalogue is structured in three technological blocks (Robotics, Augmented Reality and Exoskeletons) and one transversal technology, related to digitalization common to all developments. This initial classification is subdivided into user-centric tools.

Each tool, presented as a brochure, provides information about the partners involved, an overview of the technical functionalities, and the target application.

Main blocks are shortly explaining, further information can be found in the catalogue itself and the specific technical deliverables describing the technologies (D1.3, D1.5, D1.6, D1.8, D1.9, D2.2, D2.3, D3.2, D3.3, D4.1, D4.2).

3.1 3D modelling and Digitalization

The Mari4_YARD project leverages the potential of the Internet of things (IoT), mobile and ubiquitous ICT tools, and robotics for implementing a novel connected shipyard, offering the European shipbuilding the opportunity to stay at the leading edge. Specifically, the project will implement a portfolio of worker-centric solutions by relying on novel collaborative robotics and ubiquitous portable solutions.

The goal in Mari4_YARD project, in terms of digitalization is the implementation of data exchange and connectivity data formats for achieving vertical integration between the solutions and systems developed in Mari4_YARD with the shipyards IT infrastructure.

Detailed information about definition and implementation as well as the general overview of the digital platform for achieving interoperability with the already existing integrated marine design software –i.e., AVEVA and CADMATIC— can be found in Deliverable D1.6.

In addition to the general communication architecture, some technologies linked to the use of drones were developed in the project and showed in the catalogue:

- Drone to perform 3D Scanning (GHENOVA)
  3D Laser scanning and Lidar used not only for 3D modelling and reverse engineering, also assessed for production control.
- Small Drone for confined spaces (GHENOVA/AIMEN)
  System to detect dangerous atmospheres inside the confined spaces.

Figure 1. Drone for dangerous environment detection

3.2 Robotics

The advances in Human-robot collaboration allows the integration of robots in human environments, increasing accuracy, efficiency and productivity.

Tools developed in Mari4_YARD project consist in a portfolio for collaborative operations in the shipbuilding sector, covering different scenarios related to the diversity of manufacturing sectors.

Figure 2. Mobile robot (pick&place).

Technologies, as described in deliverable D2.3, are focused on:

- Provision of collaborative robot-based solutions that allow the improvement of production performance and precision, preserving industry-specific knowledge and worker skills, (in compliance with ISO directives for human safety and ergonomics).
- Development of a unified and adaptable robot perception system for advanced collaboration of mobile and articulated robots.
- Development of control modules for monitoring and controlling flexible robotic systems, with a focus on

Figure 3. Handguiding tool.

human-centered interfaces, with two levels of orchestration and planning: local orchestration by the Task Manager and coordination by the Production Manager.

- Development of intuitive human-machine interfaces for robot programming and control in shipbuilding.

Figure 4. Collaborative robot for welding and cutting operation

3.3 Augmented Reality

Mari4_YARD developed different technologies to represent the information, focused on production support, supervision support and maintenance support, as well as training activities.

Mari4_YARD Implements AR technologies to record work processes and enable meaningful configuration of AR/MR tools, including Projection, Spatial Computing, and Tablet-based supervision.

Solutions developed consist of:

- High precision projection and cost-effective equipment, both based on the same concepts, but using different hardware elements. On the one hand, the Spatial Augmented Reality (SAR) system. On the other hand, a cost-effective projection system using regular projector, unexpensive 3D sensor and ad-hoc pan-tilt units.

Figure 5. Cost effective projection tool

- Spatial computing on Head Mounted Displays.

- Assisting workers finding information and supporting supervision with handheld devices.

Figure 6. AR HMD app at a shipyard (left) and remote collaboration in AR within web application (right)

3.4 Exoskeletons

Exoskeletons are wearable mechanical devices designed to provide support to workers by reducing their physical effort. Two occupational exoskeletons, namely a shoulder-support exoskeleton and a lumbar-support exoskeleton, were developed within the Mari4_YARD project. Their ultimate goal is the reduction of physical strain of workers in those production stages characterized by the presence of wearing job movements for the shoulder girdle and the spine, respectively.

Figure 7 Operator using an exoskeleton in grinding activities

The shoulder-support exoskeleton is designed to provide antigravitational support to the user's arms for those job activities requiring static or repetitive shoulder flexion.

The lumbar-support exoskeleton is designed to support the user's trunk erector muscles through an assistive action delivered at the level of the lumbo-sacral joint in those job activities requiring repetitive load lifting actions or static flexion trunk poses.

The intensity of the assistance level can be manually tuned over five level. As "wearable" tools, both exoskeletons are designed to provide a comfortable human-machine interaction thanks to a light-weight structure, high kinematic compatibility ensuring for complete freedom of movement and high adaptability thanks to a set of adjustments mechanisms that allow to tailor the size of the devices to fit on specific users. Both exoskeletons are also endowed with a control unit that is devoted to acquiring kinematics information from an integrated sensory apparatus and implementing wireless MQTT protocol to share information with IoT networks.

4 Conclusions

The Portfolio of technologies and solutions developed within the Mari4_YARD technical workpackages (WP1, WP2, WP3, and WP4) are compiled into the "Catalogue of Solutions". This document elaborated for dissemination and exploitation purposes serves as an overview of the Mari4_YARD technologies for the industrial stakeholders.

The tools undergo a final validation in a relevant industrial environment. This implementation and testing takes place on operational pilot lines, i.e. in shipyards and their outfitting and prefabrication workshops.

Final validations will be carried out within the scope of WP5 and may lead to future enhancements or updates on the developments based on the experience of the technology providers and end-user's feedback.

For this reason, the online catalogue of solutions will be a living document that can be updated in its online version (in the project website & communities).

ANNEX

[Catalogue-of-the-solutions_MARI4YARD.pdf]

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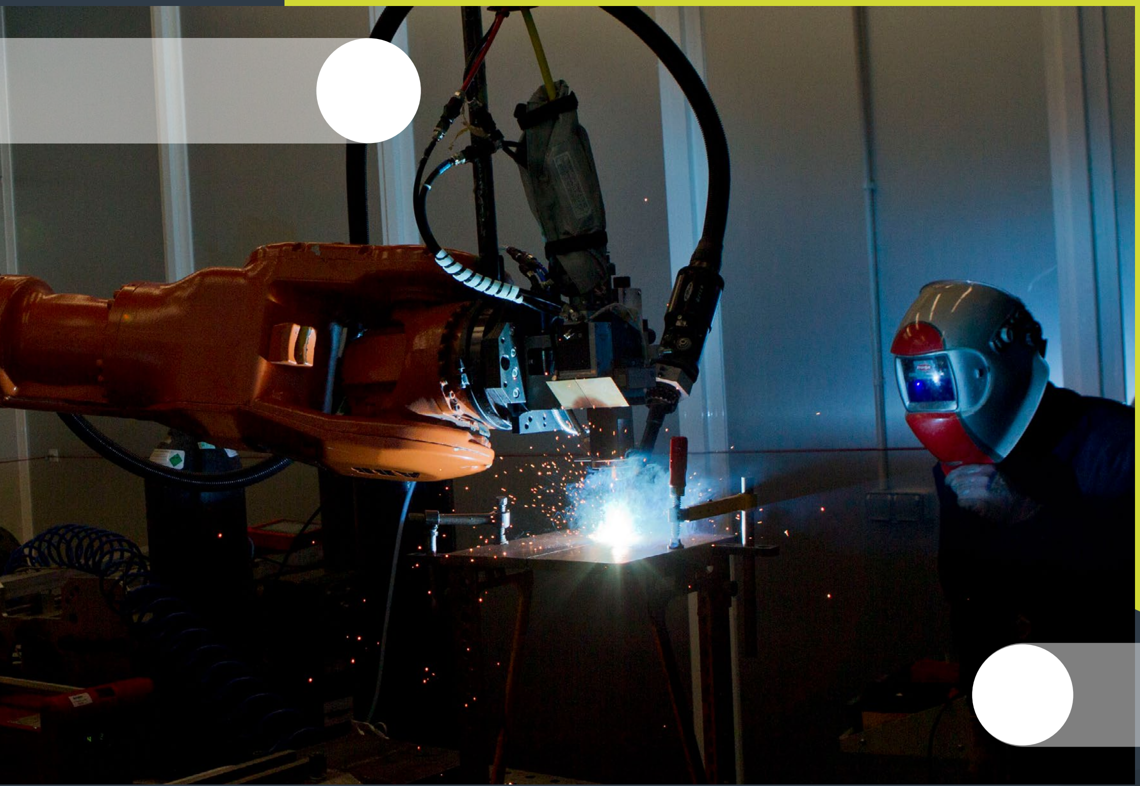
MARI4YARD

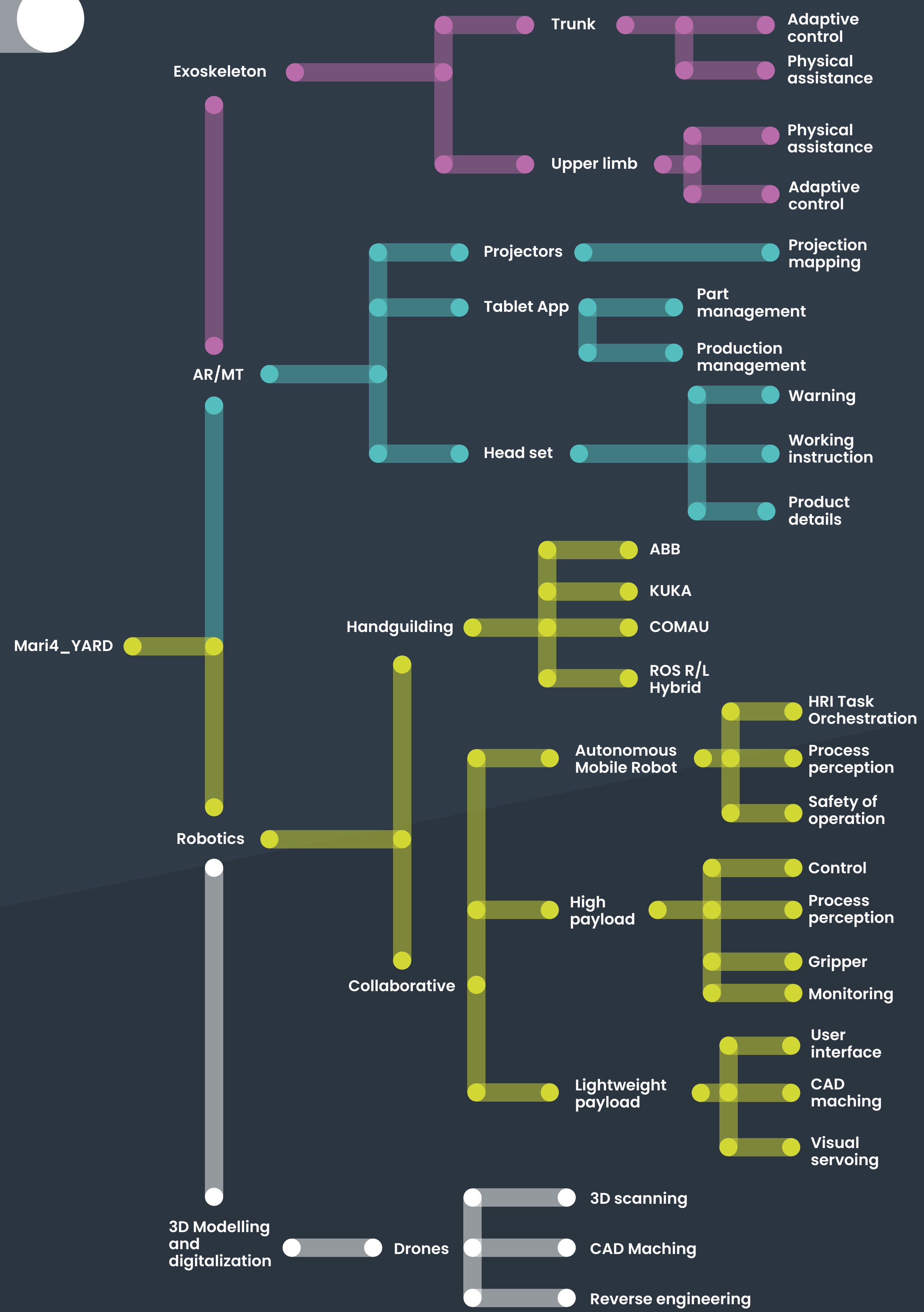
MARI4ALLIANCE

ABOUT US

Project Overview:
Mari4_YARD is an EU-funded project that leverages IoT, mobile ICT tools, and robotics to develop user-centric solutions for flexible and modular manufacturing. It implements worker-centric solutions using collaborative robotics and portable devices, preserving industry-specific workers' knowledge, skills, and health. The project is adopting a twofold strategy: technology-driven and barrier-driven.



Portfolio Objectives:
1. Overview of all the technologies and tools developed in the Mari4_YARD project.
2. Serve as a document for presenting the portfolio and marketing of the technologies and tools.
3. Concise one page for each technology with four sections: Summary, Involved Partners, Technology, Applications.

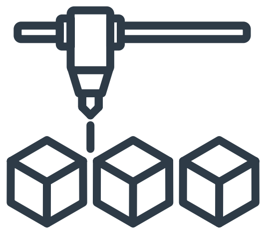


2 TECHNOLOGICAL BLOCKS

The Mari4_YARD project provides technologies based on 3D modeling, digitalization, robotics with a multilayer safety system, augmented reality for onsite support, and exoskeletons for physical assistance in manual welding and cutting operations at naval construction sites.

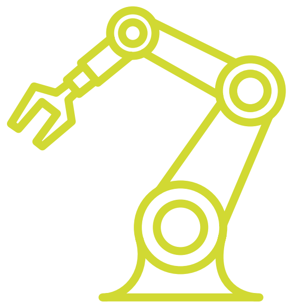
3D modelling and digitalisation

Mari4_Yard implements a methodology that achieves vertical integration between marine software tools and user-centric tools, supporting traceability and interoperability.



Robotics

Mari4_YARD implements robotics technologies, including industrial robots, mobile manipulators, and collaborative robots with a multi-layered safety system.

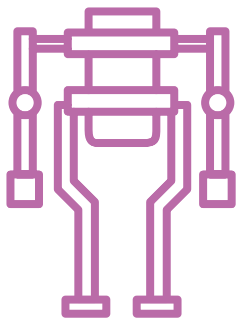


Augmented reality

Mari4_YARD implements AR technologies to record work processes and enable meaningful configuration of AR/MR tools, including Projection, Spatial Computing, and Tablet-based supervision.

Exoskeletons

Mari4_YARD implements wearable technologies, including lightweight and portable exoskeletons for shoulder and back antigravitational support for manual naval operations.



3 USER-CENTRIC TOOLS

The Mari4_YARD project focuses on user-centric tools within four technology blocks, which prioritize the needs, preferences, and experiences of small and medium shipyards. These user-centric approaches are implemented during three test sprints. In the following, you can find each tool being demonstrated, including the involved partners, specifications with video/pictures, target applications, and impact.

DRONE TO PERFORM 3D SCANNING (GHENOVA)

The use of technologies linked to 3D Laser scanning and Lidar are giving to the shipyards a very powerful tool not only for 3D modelling and reverse engineering, also by means the use of specific tools gives the possibility to be useful on the production control.

Involved partners

aimen TECHNOLOGY CENTRE · GHENOVA

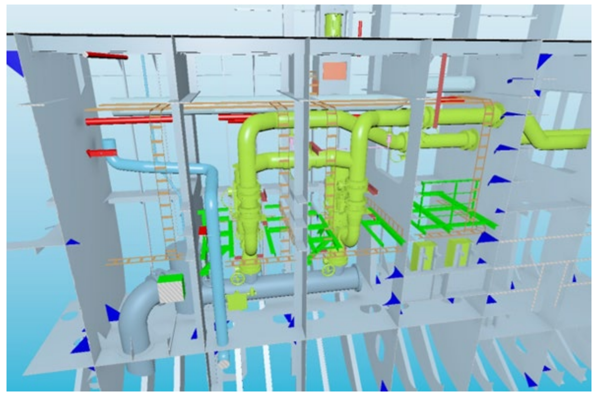
Technology

Three different technologies are combined to create the collaborative solutions:

- 3D scanning by means of 3D laser scan.
- 3D scanning by means of Lidar scan.
- 3D scanning by means of photogrammetry.

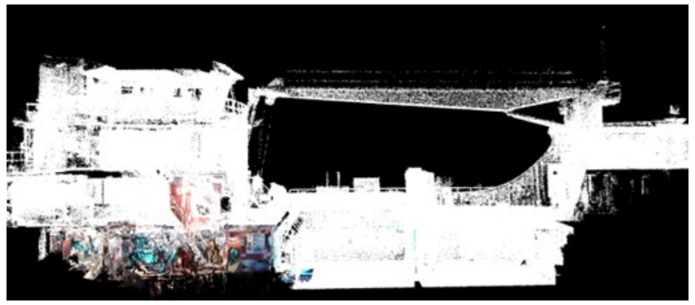
Applications

Retrofit:



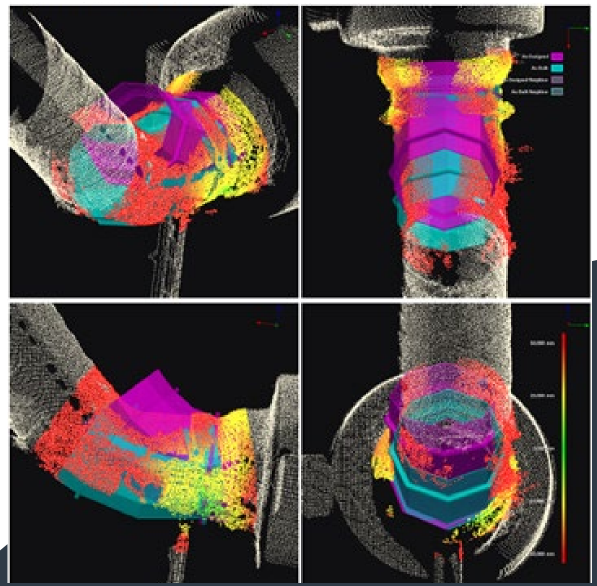
Piping modeled over 3D point cloud

As built information:



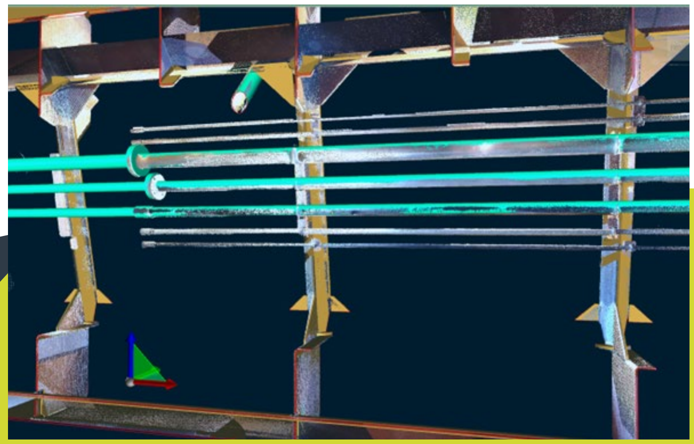
Combined 3D laser scan with lidar

Production control:



Differences between 3D model and reality by using 3D scan

Advance control:



Scan over 3D model

SMALL DRONE FOR CONFINED SPACES (GHENOVA/AIMEN)

We have developed a system to validate the safety of workers inside confined fabrication spaces. It consists of a small drone that should carry out supervision tasks to ensure that the work environment is safe for operators to access, for which an oxygen sensor has been added to the drone.

Involved partners

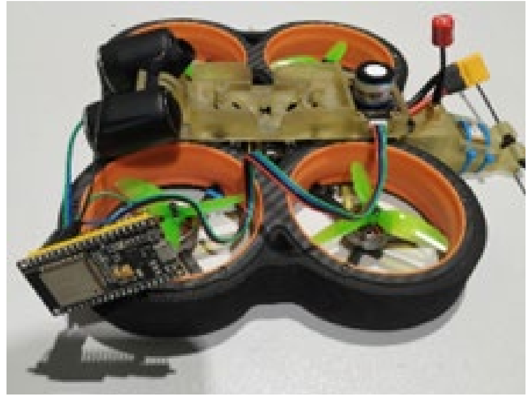
GHENOVA · aimen TECHNOLOGY CENTRE

Technology

Reading of sensors through I2C protocol by ESP32 board, for subsequent packaging based on the CRSF protocol and sending through radio frequency communication in the 868MHz band, from small drone to its remote control.

Applications

The main application of this system is to monitor oxygen levels inside port tanks.
It detects the concentration of oxygen in confined spaces and alerts workers in case of any risks. This solution ensures safety in the work environment by the integration of new sensing technologies in small drones.



HAND-GUIDING OF INDUSTRIAL ROBOTS (LMS/AIMEN)

We have collaborated to adapt the hand guiding technology, originally developed by AIMEN for ABB robots. For Mari4_YARD this technology is adapted for KUKA and COMAU robots. The main benefit is the adoption of industrial robots for collaborative applications, so working payloads and applications can be increased for industrial robots.

Involved partners

LMS Laboratory for Manufacturing Systems & Automation

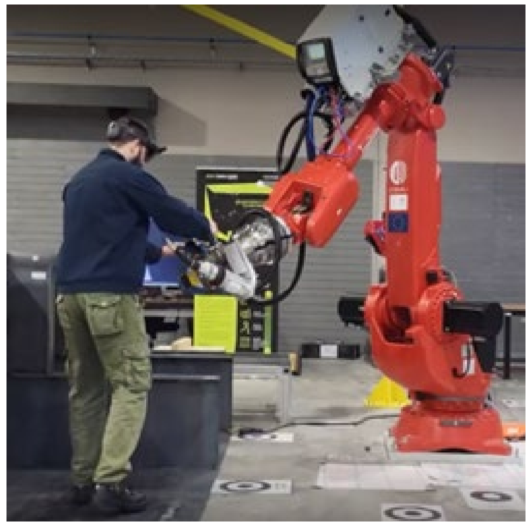
aimen TECHNOLOGY CENTRE

Technology

Hand guiding technology consists of moving the robot by direct operator interaction with a device placed at robot's wrist. Robot is also equipped with a Force/Torque sensor and high-speed communication protocol to monitor forces and torques applied by the operator in real-time. The controller can be configured for smooth operations.

Applications

The main application of the hand guiding technology is to assist the user to manipulate the heavier loads. The It's key impacts are: to reduce the risk of human injuries due to load manipulation, to lower the programming time, and to expand the applications of industrial high payload robots.



COLLABORATIVE ROBOTS (CANONICAL/ AIMEN)

Use of small robots to perform semi-autonomous operations to extend the workers capabilities in the pre-fabrication and outfitting stages. It is considered the possibility of deploying the solution in confined spaces and inside the ship for both new construction and retrofitting.

Video

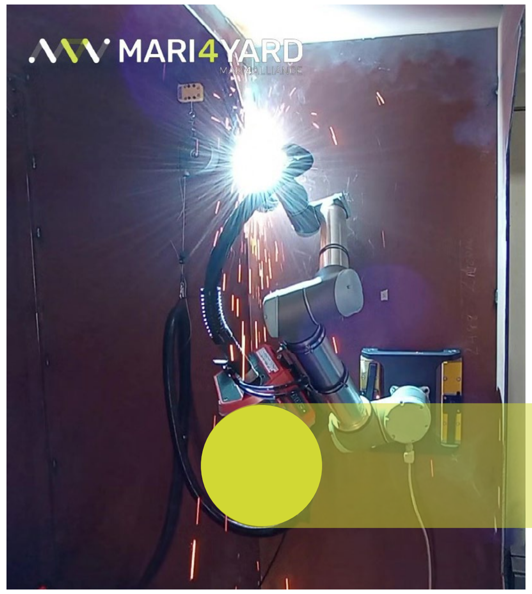
https://bit.ly/3OAN439

https://bit.ly/3KkSuwx

Involved partners

CANONICAL ROBOTS

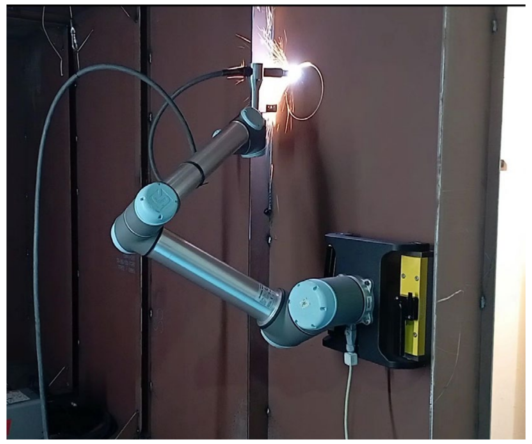
aimen TECHNOLOGY CENTRE



Technology

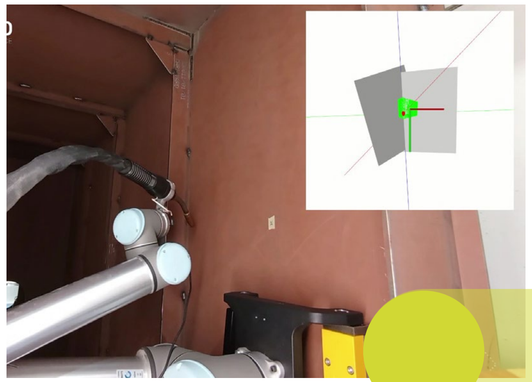
Three different technologies are combined to create the collaborative solutions:

- Collaborative robots with Power and Force Limiting (PFL) operational mode (conforms to the TS 15066)
- Fast programming by means of hand-guiding and localization using perception and CAD matching
- Advanced perception for semi-autonomous operation



Applications

The use of collaborative robots in welding and cutting operations is an excellent way to increase productivity and efficiency. Collaborative robots are an ideal choice for small and medium-sized manufacturers who deal with low-volume, high-mix production. They can perform different tasks in a day and can adapt to new sizes and geometries. Mari4_YARD collaborative technology solutions are designed to work with humans in a shared space, and they can help reduce the chance of impact with human co-workers.



AUTONOMOUS MOBILE ROBOTS (INESC TEC)

The use of autonomous mobile manipulators to transport raw materials and individually manufactured parts between stores and workshops, as well as between workshops and subassembly areas, increasing the intra-logistic process efficiency while also freeing up human resources for higher-value tasks.

Video

https://bit.ly/3OCVOpE

https://bit.ly/3OcptV7

https://bit.ly/3YdhpI8

Technology

Four different technologies are combined to create collaborative solutions:

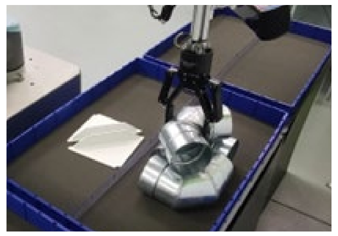
- Mobile Manipulator composed of an autonomous mobile platform and a collaborative robot.
- Skill-based programming for fast and intuitive teaching of new robotic tasks.
- Intuitive Human-Robot Interaction based on augmented reality.
- Advanced perception for long-term autonomy (autonomous navigation and CAD-based perception and grasping).

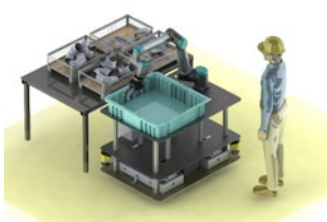
Applications

Individual parts transportation in shipyards is still nowadays heavily reliant on human operators. This transportation is typically performed by hand or using self-propelled, pulled or pushed platforms. However, since these logistic tasks are dull, dirty and dangerous for the human operator, and due to the aging of the European population, it is important to liberate and empower the current human workforce to perform more added-value tasks. Therefore, there is a high interest in the shipbuilding sector to automate its intra-logistic operations. To answer these challenges, Mari4_YARD proposes using a mobile manipulator to pick individual parts from containers, combining AGV capabilities with robotic arm manipulation dexterity. The developed technologies are hardware agnostic, allowing for easier deployment to different robot hardware configurations while taking into account different application requirements.

Involved partners

INESCTEC





HIGH PRECISION PROJECTION SYSTEM (INESC TEC)

The use of a projection-based augmented reality tool with 3D perception to assist human operators when performing marking and cutting of a metal structure. The solution allows the operator to work faster and without requiring measurement tools. It can also be used to assist the human operator when programming collaborative robots for cutting operations by providing visual guidance of the task.

Video

https://bit.ly/3OCWb3w

Involved partners

INESCTEC

Technology

The projection mapping solution relies on a 3D perception system, a 3D rendering SDK and a 4K DLP projector to project information directly in the target object. Its primary advantage is that human operators do not need to use measurement tools. The projector and the 3D sensor are on a moveable tripod to not interfere with the operator's field of view. The system has several modules, which include computer vision software for performing the hardware calibration in the setup phase, while relying on a GUI during the deployment phase for providing an intuitive interface for the operator to quickly load new CAD models, trigger the 3D perception module and project task-oriented information into the environment for marking and cutting operations.

Applications

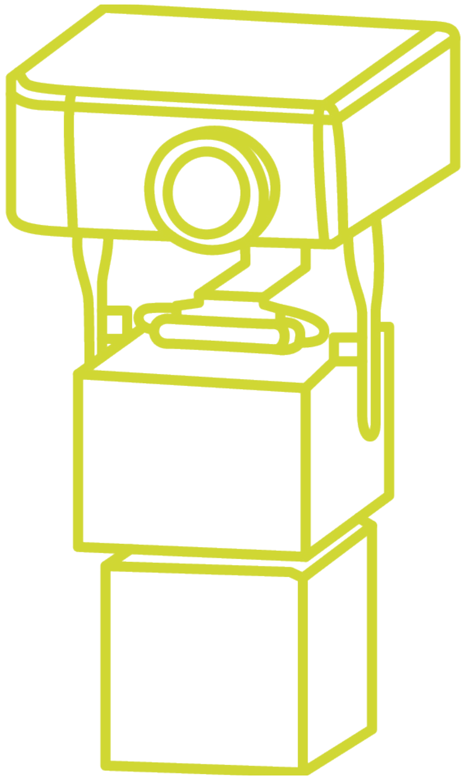
The system provides an immersive Human-Machine Interface for helping human operators perform their tasks, such as marking, and cutting, assembly of supply modules in outfitting, among others. This immersive interface enables the direct transmission of the design specifications into the environment, and as such, allows the human operators to perform these tasks faster, more accurately and with fewer mistakes, without relying on error-prone measuring devices and printed documents.

COST EFFECTIVE PROJECTOR (AIMEN)

This system extends the workers capabilities to perform semi-autonomous operations at the pre-fabrication and outfitting stages. The aim is to replace the traditional paper-based drawings and project such drawings on the target with accuracy and precision.

Involved partners

aimen TECHNOLOGY CENTRE



Technlology

- **Scanning the area:** This feature is exercised with the help of the pan-tilt unit and low cost RGB-D camera.
- **Localization algorithm:** It consists of matching the point cloud acquired in the scanning phase with the CAD of the area by user initial guess, ICP algorithm, and projection of elements.

Application Impact

Projection systems in construction and retrofitting increase productivity and efficiency. They are ideal for small and medium-sized manufacturers dealing with low-volume, high-mix production. These systems reduce paper documentation and human errors, allowing technicians to focus on operations. They also serve as a quick verification tool for new designs and features. Mari4_YARD's projection technologies work in shared spaces, reducing the chance of impact with human co-workers.

AUGMENTED REALITY WITH HEAD-MOUNTED DEVICES (TTPSC)

Technology

Shipyard workers are equipped with ruggedized HMD (head-mounted devices) that are attached to safety helmets and having connectivity, monocular camera, microphones, noise cancellation algorithms and TTPSC SkillWorx system leveraging computer vision and remote SLAM. That setup gives the workers full hands-free experience to check, record and document construction progress, completion, and quality of delivered work and follow digital work instructions.

Applications

HMD App: Navigate workers within physical environment using spatial intelligence – application streams video feed to remote SLAM server to build in real-time 3D map that allows onsite and remote workers to tag and overlay information on the real 3D world while also maintaining safety, situational awareness, low eyestrain, hands-free use, and full-shift battery life.
Web App: Collaboration endpoint for over-the-shoulder help during construction, inspection, repair, troubleshooting, review etc. as remote assistance enriched with real-time AR (when onsite worker and remote supporters can collaborate and place sticky, pervasive AR annotations on a live video). AR is placed on video from ultra-low bandwidth low resolution up to 4K and is stored in a form of reusable 3D maps.

Involved partners

psc_ TRANSITION TECHNOLOGIES

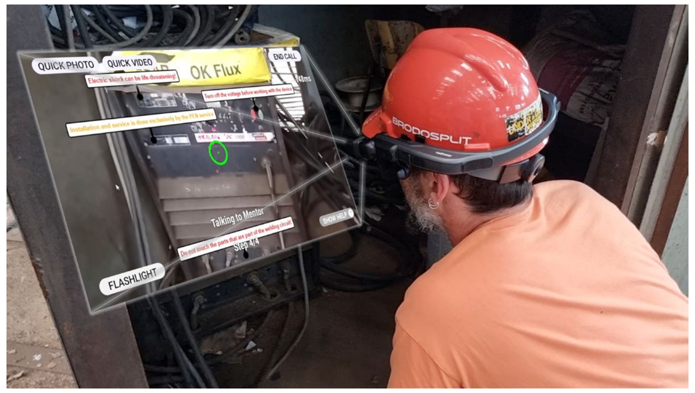
Video

https://bit.ly/3QhUmtS

Impact

The system serves as a source of information for field workers during on-the-job activities.
Main benefits:

- Act as fast as possible during real-time supervision, troubleshooting, inspections, repairs, reviews.
- Access to the right information without sacrificing worker safety nor comfort.
- Streamlined communication and collaboration during field work with increased transparency and situational awareness.



EXOSKELETON FOR LUMBAR SUPPORT (IUVO/SANT'ANNA)

Involved partners

IUVO — LMS Laboratory for Manufacturing Systems & Automation — Sant'Anna Scuola Universitaria Superiore Pisa

EXOSKELETON FOR SUPPORT OF SHOULDER FLEXION (IUVO/SANT'ANNA)

Video

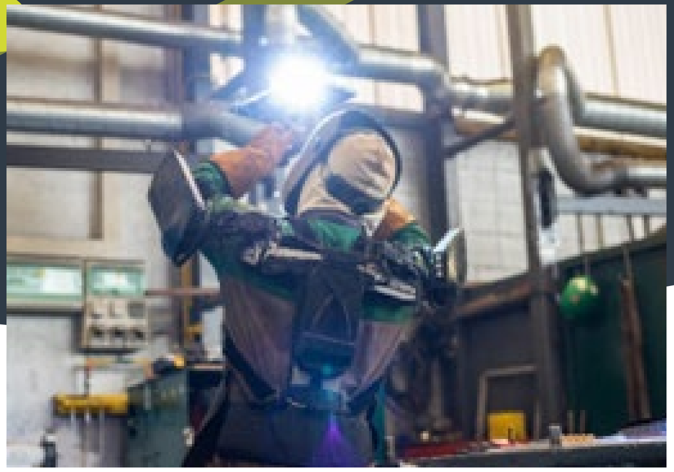
https://bit.ly/43QanKT

Technology

Exoskeletons are wearable mechanical devices designed to provide support to workers by reducing their physical effort.
Two occupational exoskeletons, namely a shoulder-support exoskeleton and a lumbar-support exoskeleton, were developed within Mari4_YARD project. Their ultimate goal will be to reduce physical strain of workers in those production stages characterized by the presence of wearing job movements for the shoulder girdle and the spine, respectively.
The shoulder-support exoskeleton is designed to provide antigravitational support to the user's arms for those job activities requiring static or repetitive shoulder flexion. Thanks to an embedded battery-operated control unit, the exoskeleton is capable to adjust the provided support depending on the inherent effort of the working activity though effort-based and perception-based adaptive algorithms. The lumbar-support exoskeleton is designed to support the user's trunk erector muscles through an assistive action delivered at the level of the lumbo-sacral joint in those job activities requiring repetitive load lifting actions or static flexion trunk poses.
The intensity of the assistance level can be manually tuned over five levels.
As "wearable" tools, both exoskeletons are designed to provide a comfortable human-machine interaction thanks to a light-weight structure, high kinematic compatibility ensuring for complete freedom of movement and high adaptability thanks to a set of adjustments mechanisms that allow to tailor the size of the devices to fit on specific users. Both exoskeletons are also endowed with a control unit that is devoted to acquiring kinematics information from an integrated sensory apparatus and implementing wireless MQTT protocol to share information with IoT networks.

Applications

Exoskeletons have gained attention in recent years as a potential solution for reducing workplace injuries and improving productivity in physically demanding jobs. While automation is often heralded as a solution in industries that require repetitive or heavy manual labor, many shipbuilding working activities require flexibility, adaptability, or sensitivity to navigate and operate in complex environments. This is where exoskeletons result useful advanced tools for supporting workers improving ergonomics in those activities that require prolonged static postures or repetitive movements that can cause musculoskeletal discomfort.



Impact (including target/users and benefits)

Occupational exoskeletons for shoulder and lumbar support are attracting attention of several stakeholders given their potentiality to prevent work-related musculoskeletal disorders. Several studies conducted in successful use-case applications demonstrated efficacy of exoskeletons in reducing the biomechanical overload of the assisted district. Preserving industry-specific workers' knowledge, skills and biomechanics health status is essential for the competitiveness of small and medium-scale shipyards. Lowering physical strain, assistive exoskeletons are expected not only to improve safety and ergonomics of the working condition but also to impact quality and productivity enhancing precision and avoiding fatigue-induced errors.

AUGMENTED REALITY WITH HANDHELD DEVICES (TUHH)

Involved partners

TUHH
Technische Universität Hamburg

Technology

The technology is a user-centric tablet application for easy checking of construction progress in a designated construction area. In addition to this, a web application was developed to prepare and provide the data for the tablets and also serve as a user interface for clear evaluation of the progress recording.

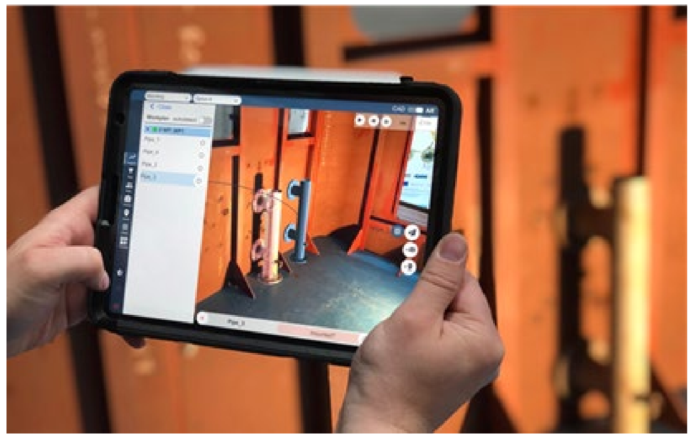
Applications

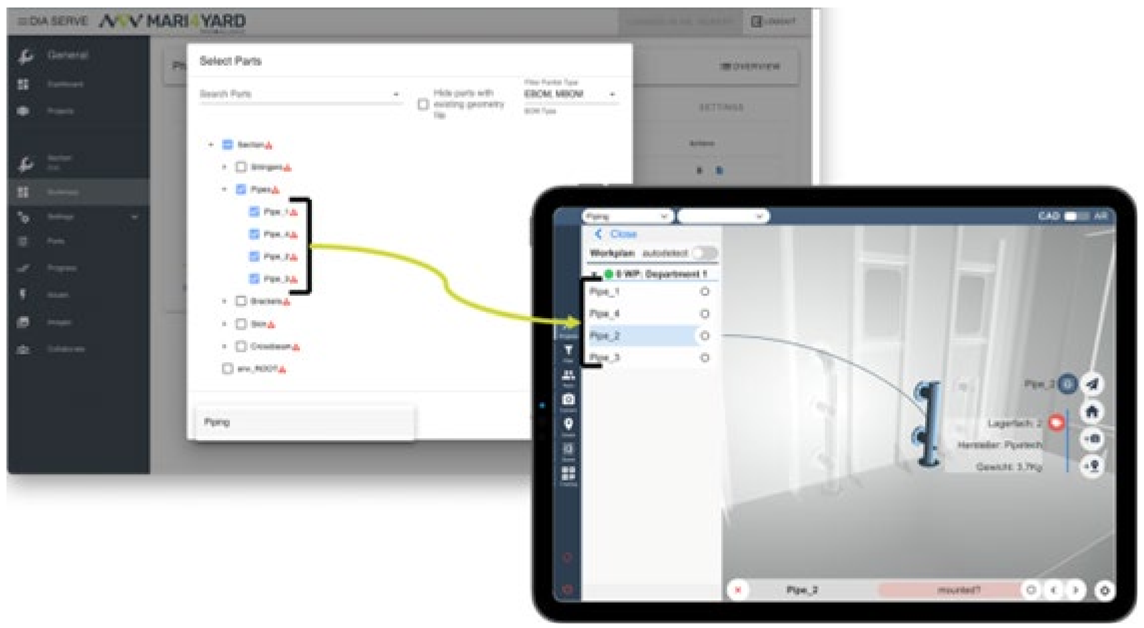
Web App: can be filled manually or automatically by third party systems. It serves as an endpoint for the
Tablet App: Navigate the working environment in CAD or AR mode to carry out described work processes. After that, the progress can be monitored by supervisors in the web Application.

Impact

The system serves as additional source of information for the workers, while no special skills are required. Three main benefits that are to be expected:

- Faster recording of construction progress
- More precise recording of the progress
- Faster and more transparent communication of the actual progress





HIGH PAYLOAD COLLABORATIVE ROBOTS (LMS)

A high-payload robot, empowered by AI, is used in shipyards for the picking, positioning, and welding of heavy metal parts. Precise parts positioning is supported by manual guidance while welding path teaching is supported by intuitive AR programming interfaces. Safety systems are properly integrated for Speed and Separation Monitoring HRC.

Involved partners

LMS Laboratory for Manufacturing Systems & Automation

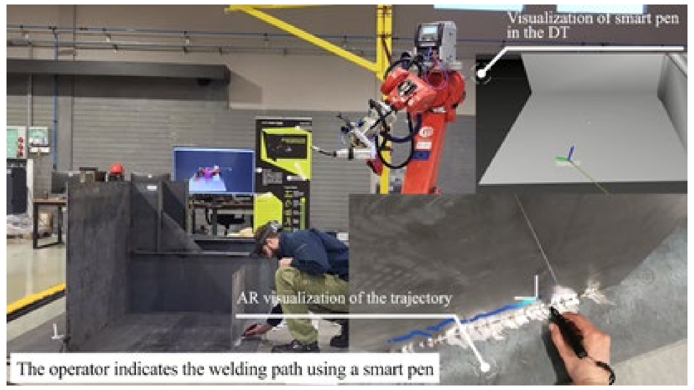
GIZELIS ROBOTICS

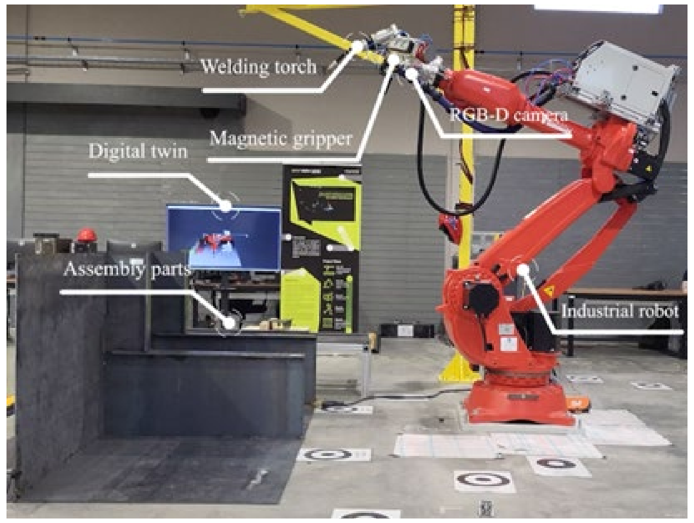
Technology

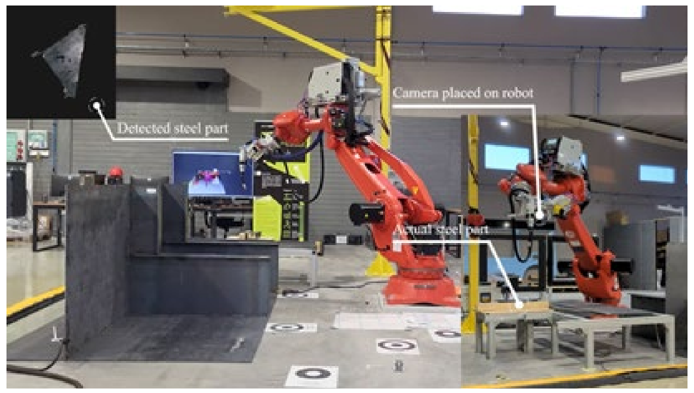
The proposed solution combines several technologies: Speed and Separation Monitoring HRC, direct and indirect human-robot interaction for parts positioning and AR-assisted welding path teaching, advanced perception for bin picking operations, multilayer safety system, and a multimodal gripper (with magnets for picking tasks, welding torch for welding, F/T and vision sensors.

Applications

High payload robots are being utilised in shipbuilding to enhance productivity and working conditions. They handle strenuous tasks like manipulating heavy parts, while human operators guide them. The tools developed offer adjustability and ease of use for non-expert users. AI-enhanced machine vision and AR technology support operators in detecting and manipulating parts, programming robot paths, and ensuring safety through a multilayer safety system.







CONCLUSIONS

"The user-centric tool brochures of Mari4_YARD are bundled into one catalog. The technologies are first classified into four technological blocks, which are further subdivided into user-centric tools.
Each tool provides information about the partners involved, an overview of the technical functionalities, and the target application. This catalog serves as an overview of the Mari4_YARD technologies for the industrial stakeholders and will also be a part of the Mari4_YARD website."

Designed by: deepblue