Socio-Physical Interaction Skills for Cooperative Human-Robot Systems in Agile Production

SOPHIA Exploitable Results

(final results, 31st May 2024)

H2020-ICT2019-2
(GA 871237)

T10.2: SOPHIA exploitable results – Overview (page 1/2)

Item	Title	Lead	Status	Channel	TRL
A. Robots / Cobots including Controls & Accessories					
#1	Mobile Collaborative Robot Assistant (MOCA)	IIT	completed	License to companies/spinoff	**TRL7**
#2	XbotCore Robot Control Framework	IIT	completed	License to companies/spinoff	**TRL6**
#3	Loco-manipulation & interaction control framework for mobile manipulators	IIT	completed	License to companies	**TRL6**
#4	MOCA-MAN interface	IIT	completed	License to companies	**TRL7**
#5	SoftHand X	UNIPI	completed	License and/or open source	**TRL6**
#6	SoftGlove	UNIPI	completed	License and/or open source	**TRL6**
#7	SoftHand Scaled Version	UNIPI	completed	License and/or open source	**TRL5**
#8	SuiHapTic (Sensorized Suit)	UNIPI	completed	License and/or open source	**TRL5**
#9	Control architecture for improved HRC	VUB	completed	Open-source software	**TRL5**
#10	Flexible screen for robot-to-human communication	VUB	completed	License to companies/spinoff	**TRL7**
#11	Visuo-haptic interface for connected and remote robot control	IIT	completed	License to companies/spinoff	**TRL7**
B. Wearbots / Exoskeletons					
#12	Exo-Muscle knee assistive device	IIT	completed	License to companies/spinoff	**TRL5**
#13	Elbow Assistive Device	IIT	completed	License to companies/spinoff	**TRL5**

TRL-definition according to: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

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Item	Title	Lead	Status	Channel	TRL
C. Human Modeling Software & Simulation					
#14	HRI30: An Action Recognition Dataset for Industrial HRI	IIT	**completed**	Open-source dataset	**TRL4**
#15	Open-VICO: An Open-Source Gazebo Toolkit for Skeleton Tracking	IIT	**completed**	Open-source software, API	**TRL4**
#16	Worker Capture System	UM	**completed**	Open-source software, API	**TRL4**
#17	Human action-activity Dataset	UM	**completed**	Open-source dataset	**TRL4**
#18	Enhanced HRC functions for ema simulation & Omniverse connector	IMK	**completed**	Commercial software (emaWD)	**TRL8**
#19	Real-time human musculoskeletal modelling	UT	**completed**	Commercial software license	**TRL6**
#20	Framework for Multi-Modal Physiological Sensing	VUB	**completed**	Open-source software	**TRL5**
#21	Antropo-social communication interface	VUB	**completed**	Open source software	**TRL5**
D. Methods, Tools & Standards					
#22	Instrumental-based tool for monitoring/classifying biomechanical risk	INAIL	**completed**	License, Consultancy services	**TRL6**
#23	Human Ergonomics Database	INAIL	**completed**	Open ac. database, Publication	**TRL8**
#24	Questionnaire to evaluate the dialog design of HRI systems	BAuA	**completed**	Open access publication	N/A
#25	Exoskeleton acceptance & suitability assessment	VUB	**completed**	Consultancy services	N/A
#26	Standardization document(s) on HRC and biomechanical assessment	DIN	**completed**	Publication of standard doc.	N/A

TRL-definition according to: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

T10.2: SOPHIA exploitable results

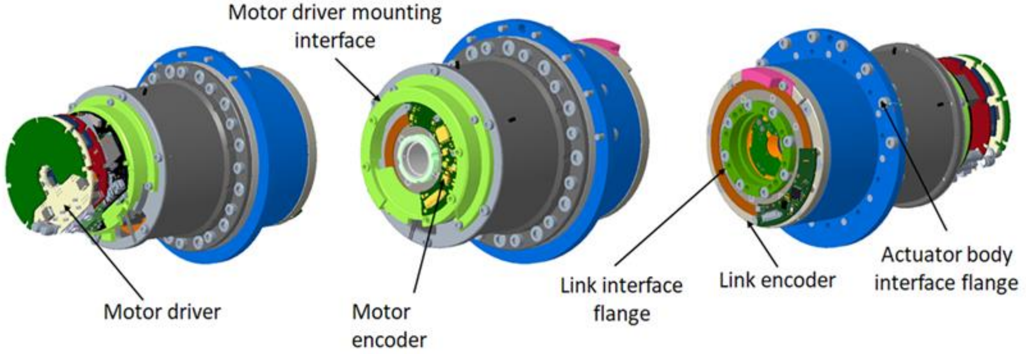
A. Robots / CoBots; Controls & Accessoires

T10.2: SOPHIA exploitable results
#1 Mobile Collaborative Robot Assistant (MOCA)

Back to overview

Description/Contents:

- Two new actuation units were designed to address the requirements of the SOPHIA cobot.
- Inherited from the original IIT-HHCM drives.
- Higher torque range as required by some of the SOPHIA cobot joints.
- Incorporate a brake at the back of the actuator.
- The units share the same mounting interfaces.



Background knowledge:

- Series elastic actuation (Centauro robot)
- Custom and embedded motor driver

Lead partner: IIT

Involved partners: -

Work Package: WP8

Exploitation channel:

- Licensing to companies and/or spin-offs

TRL 7

Current status & next steps:

- Arm designed and tested

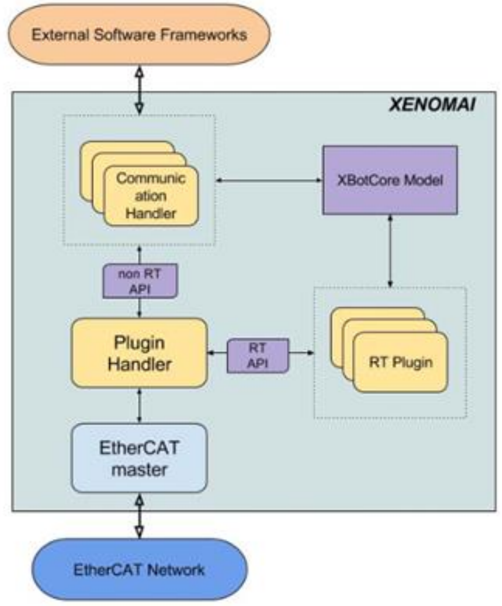
T10.2: SOPHIA exploitable results

#2 XbotCore Robot Control Framework

Back to overview

Description/Contents:

- Light-weight, Real-Time (RT) software framework for EtherCAT-based robots that satisfies hard RT requirements, ensuring 1 kHz control loop even in complex Multi-Degree-Of-Freedom systems.
- Simple and easy-to-use middleware Application Programming Interface (API), for both RT and non-RT control frameworks.
- Flexible with respect to the framework a user wants to utilize.
- Reuse of the code using XBotCore API with different robots.



Background knowledge:

- Early versions of XbotCore Robot Control Framework

Lead partner: IIT

Involved partners: -

Work Package: WP8

Exploitation channel:

- Licensing to companies and/or spin-offs

TRL 6

Current status & next steps:

- Final revision and evaluation
- Testing with SOPHIA platforms

T10.2: SOPHIA exploitable results

Back to overview

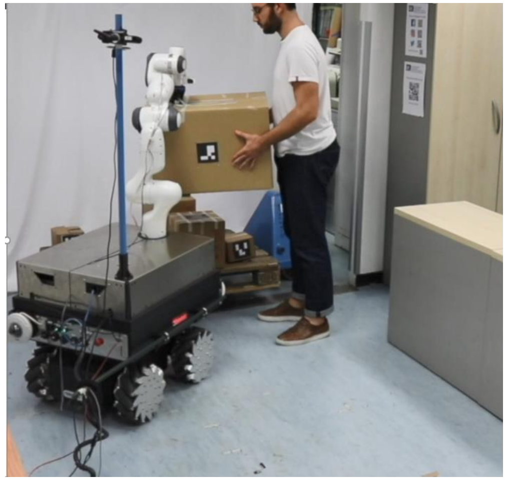
#3 Loco-manipulation & interaction control framework for mobile manipulators

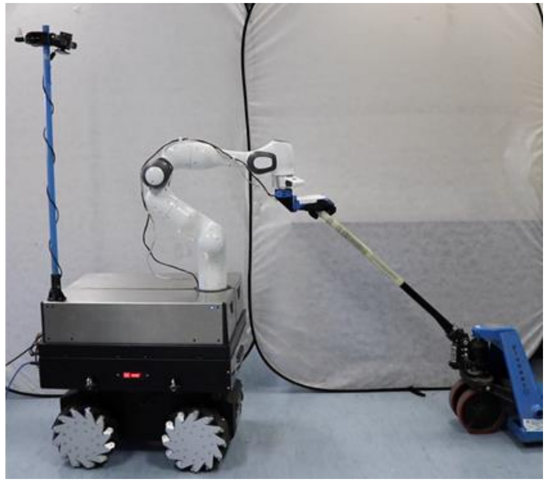
Description/Contents:

- A collaborative framework that allows Cobots to ensure safety requirements and human ergonomics, while simultaneously responding to multi-tasking scenarios.
- Hierarchical Quadratic Programming based control scheme allowing to formulate a strict hierarchy of tasks.
- Adaptive compliance control for improved human-robot collaboration.

Background knowledge:

- Humanoids and whole-body control
- Grasping and manipulation control





Lead partner: IIT

Involved partners: -

Work Package: WP7

Exploitation channel:

- Licensing to companies

TRL 6

Current status & next steps:

- Validated and demonstrated in industrial lab and pilot line demonstrations

T10.2: SOPHIA exploitable results

#4 MOCA-MAN interface

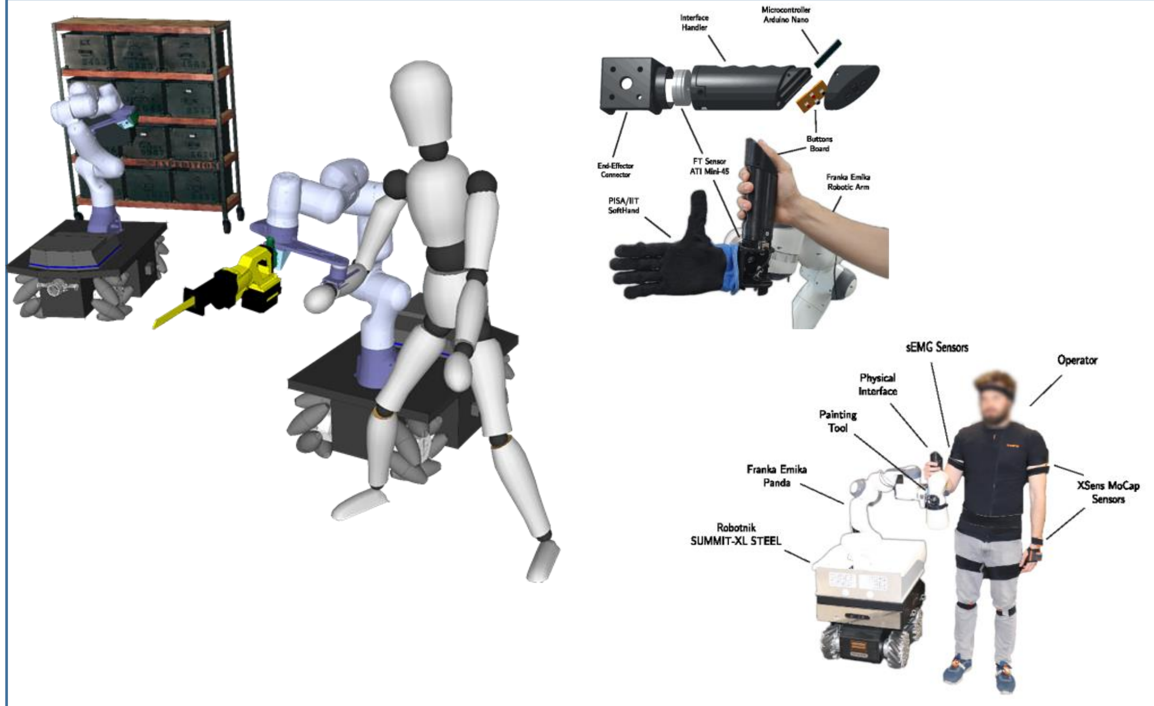
Back to overview

Description/Contents:

- A novel interface to control mobile robots for conjoined actions (supernumerary body).
- Intuitive control
- Selective control of locomotion and manipulation.
- Active gravity compensation and force production.
- Adaptive impedance control at contact.

Background knowledge:

- Humanoids and whole-body control
- Grasping and manipulation control



Lead partner: IIT

Involved partners: -

Work Package: WP7

Exploitation channel:

- Licensing to companies

TRL 7

Current status & next steps:

- New interface designed and tested
- Interface validated and demonstrated in HKP use-case

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#5 SoftHand X

Back to overview

Description/Contents:

- Two off-the-shelf gravity compensatory arm integrated with two Pisa/IIT SoftHand
- Custom braking system to lock a lifted object in any position in the arms workspace
- Improved controls to control the hands and the braking system

Background knowledge:

- Supernumerary Robotic limbs development for industrial worker assistance

Lead partner: UNIPI

Involved partners: IIT

Work Package: WP8

Exploitation channel:

- Licensing to companies / spin-off
- Open source licensing in evaluation

TRL 6

Current status & next steps:

- Prototype designed and tested in several realistic environments
- Ongoing study on improving hardware design

T10.2: SOPHIA exploitable results

#6 SoftGlove

Back to overview

Description/Contents:

- An IMU sensorized glove for posture reconstruction of anthropomorphic (human or robotic) hands
- 17 IMUs, 1 custom-made electronic board, quaternion-based complementary filtering for joint angle reconstruction
- Simple waterproofing of electronics for underwater and harsh environment tasks
- Reconstruction and visualization provided in ROS/rviz

Background knowledge:

- Posture reconstruction of soft robotic fingers and tree-like kinematic chains in ROS/rviz

Lead partner: UNIPI

Involved partners: IIT

Work Package: WP4, WP5

Exploitation channel:

- Licensing to companies / spin-offs
- Open source licensing in evaluation

TRL 6

Current status & next steps:

- Prototype designed and tested in several realistic environments
- Ongoing study on reconstruction filter extension

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#7 SoftHand Scaled Version

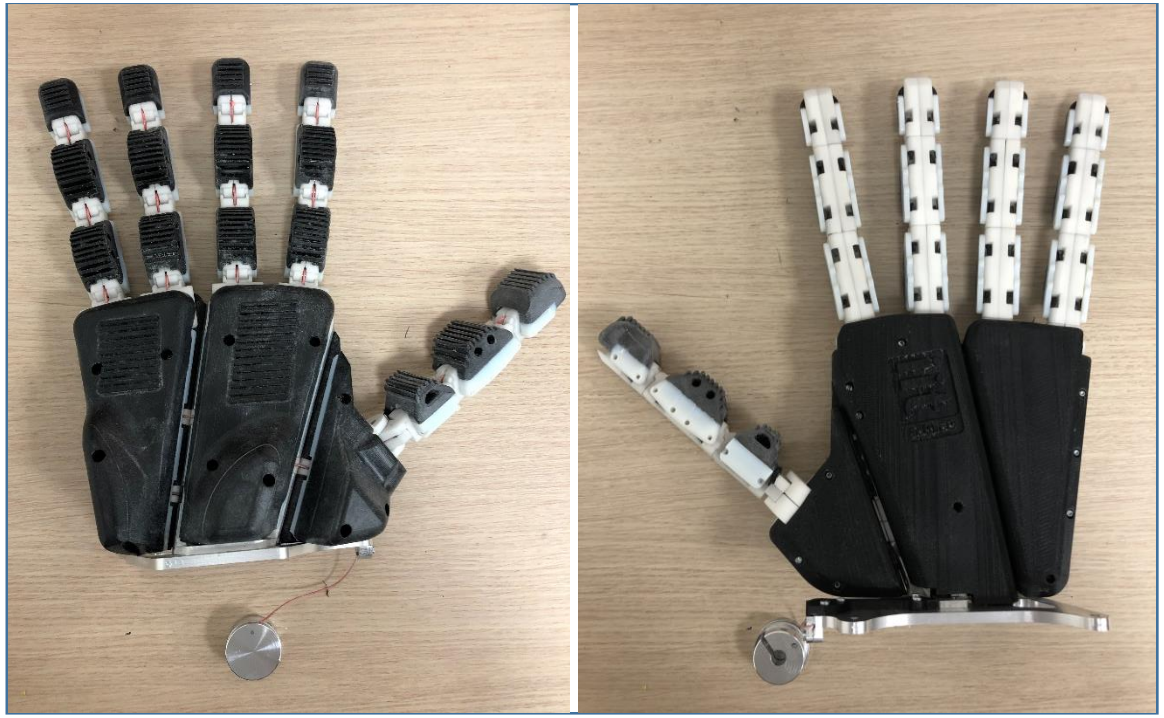
Back to overview

Description/Contents:

- An anthropomorphic hand with non-rigid palm and a large envelope for human-like grasp of huge objects
- Hand main dimension ≅ 30 cm, finger main dimension ≅ 15 cm
- Actuation and electronics can be remotized for reduced payload and waterproof tasks
- An optional set of soft pads for fingers and palm improve naturalness of interaction and grip capabilities

Background knowledge:

- An anthropomorphic hand with heavily underactuated tendon driven mechanism (19 DoFs with only 1 motor/control input)



Lead partner: UNIPI

Involved partners: IIT

Work Package: WP8

Exploitation channel:

- Licensing to companies / spin-offs
- Open source licensing in evaluation

TRL 5

Current status & next steps:

- Prototype designed and tested
- Integration test at @VW Plant Chemnitz
- Ongoing study on soft part grip, mechatronic improvement & integrated sensorization

T10.2: SOPHIA exploitable results

#8 SuiHapTic

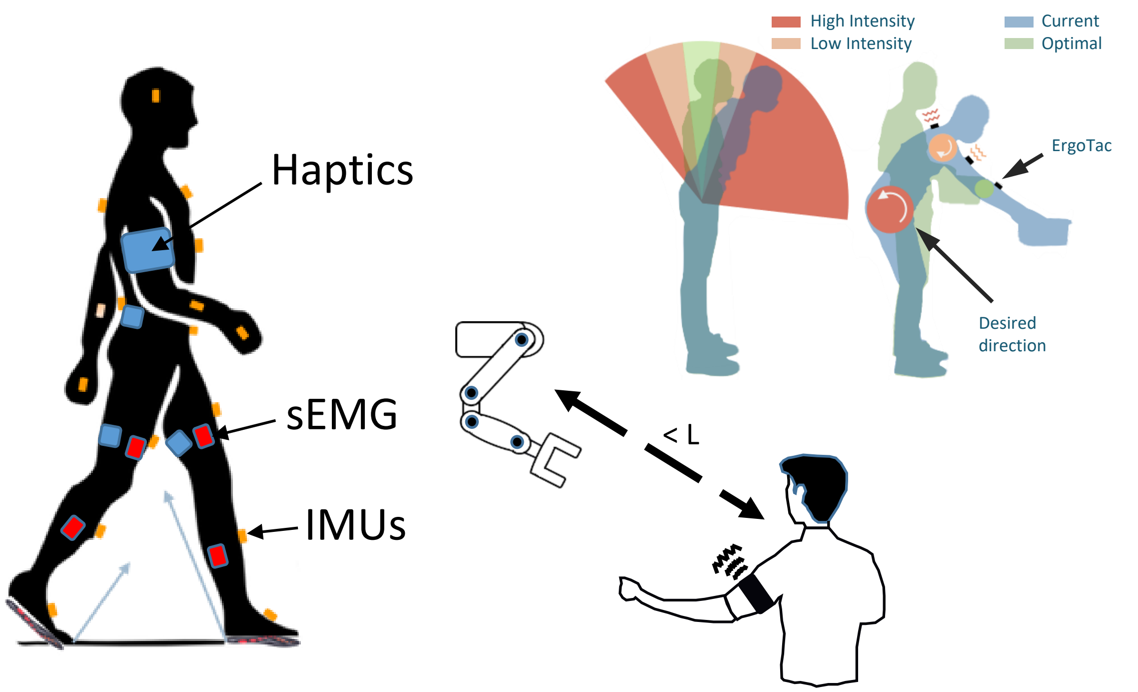
Back to overview

Description/Contents:

- A sensorized and actuated suit for nonverbal human machine communication and posture correction, with wireless communication.
- Sensing part composed of IMUs and sEMG for posture and workload computation.
- Actuation part composed of vibration-, skin stretch-, wire-based haptic devices to provide correction cues and information about the environment to the user.

Background knowledge:

- Haptic devices for human robot communication and tactile cue delivery



Lead partner: UNIPI

Involved partners: IIT, UT

Work Package: WP4

Exploitation channel:

- Licensing to companies / spin-offs
- Open source licensing in evaluation

TRL 5

Current status & next steps:

- Final version manufactured and tested
- Integrated with printable electronics and biodegradable casing

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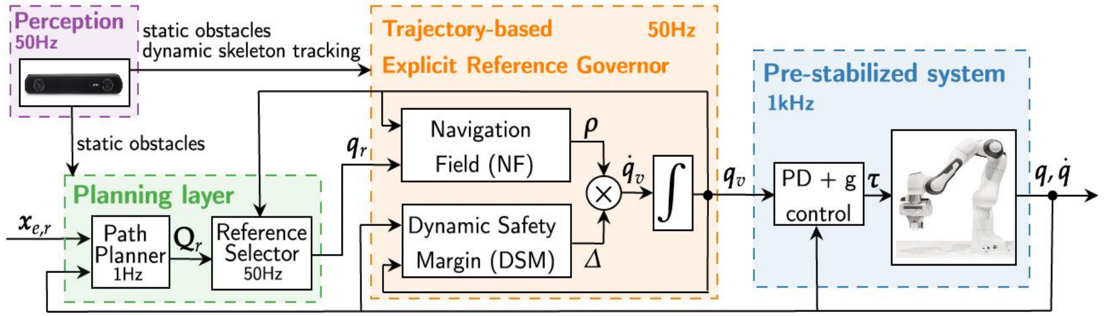
#9 Control architecture for improved HRC

Back to overview

Description/Contents:

- Combining ERG control with a motion planner for certified safe, fast, real-time robot control in human-robot shared workspaces.
- Modular ROS-based system, leveraging multicore processors and established ROS resources.
- Open source framework available on GitHub with comprehensive online documentation and tutorials.



Background knowledge:

- Existing methods and codes developed by the partners

Lead partner: VUB

Involved partners: -

Work Package: WP6

Exploitation channel:

- Open source licenses

TRL 5

Current status & next steps:

- Concepts have been described and methods have been implemented
- Software development is finished

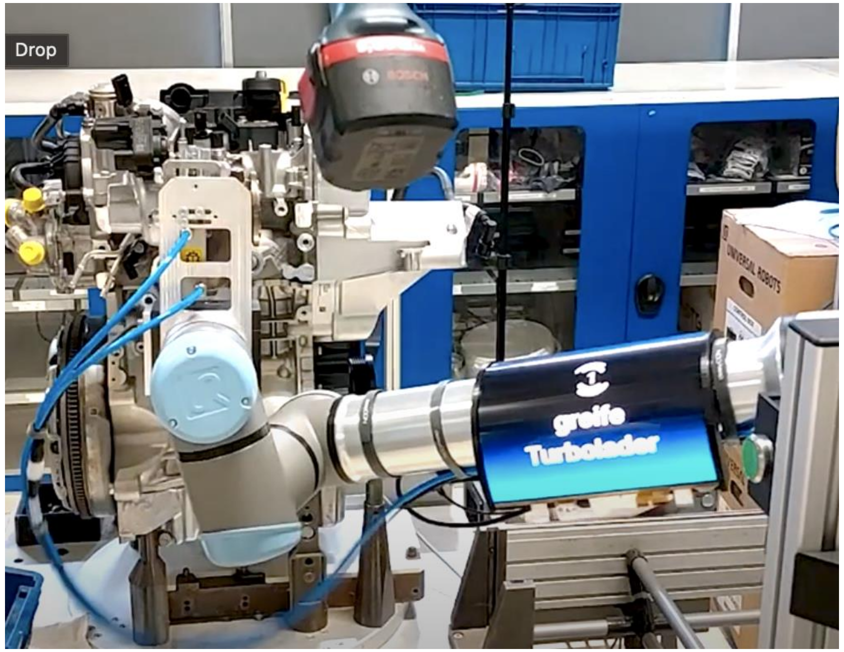
T10.2: SOPHIA exploitable results

#10 Flexible screen for robot-to-human communication

Back to overview

Description/Contents:

- A flexible screen to improve robot-to-human communication
- Visualize task progress, warnings, and errors
- Co-designed with factory workers
- Developed for UR robot and can be customized to others
- Controlled by Raspberry Pi



Background knowledge:

- Human-robot interaction and collaboration
- Raspberry Pi

Lead partner: VUB

Involved partners: BAuA, VW

Work Package: WP6

Exploitation channel:

- Licensing to companies and/or spin-offs

TRL 7

Current status & next steps:

- Hardware and software: validated
- User study: on going

T10.2: SOPHIA exploitable results

#11 Visuo-haptic interface for connected and remote robot control

Back to overview

Description/Contents:

- A haptic interface for robot guidance through FT sensor
- An additional stereo camera system for robot remote control without the need for any external tracking system
- Admittance control and VIO (Visual and Inertial Odometry)
- Usable for any fixed based and mobile robots
- Controlled by Raspberry Pi and M5stack

Background knowledge:

- MOCA-MAN Interface
- VIO / M5Stack and Raspberry Pi Programming

Lead partner: IIT

Involved partners: -

Work Package: WP5-WP7

Exploitation channel:

- Licensing to companies and/or spin-offs

TRL 7

Current status & next steps:

- Hardware and software: validated
- User study done and completed
- Ready to be exploited

T10.2: SOPHIA exploitable results

B. WearBots / Exoskeletons

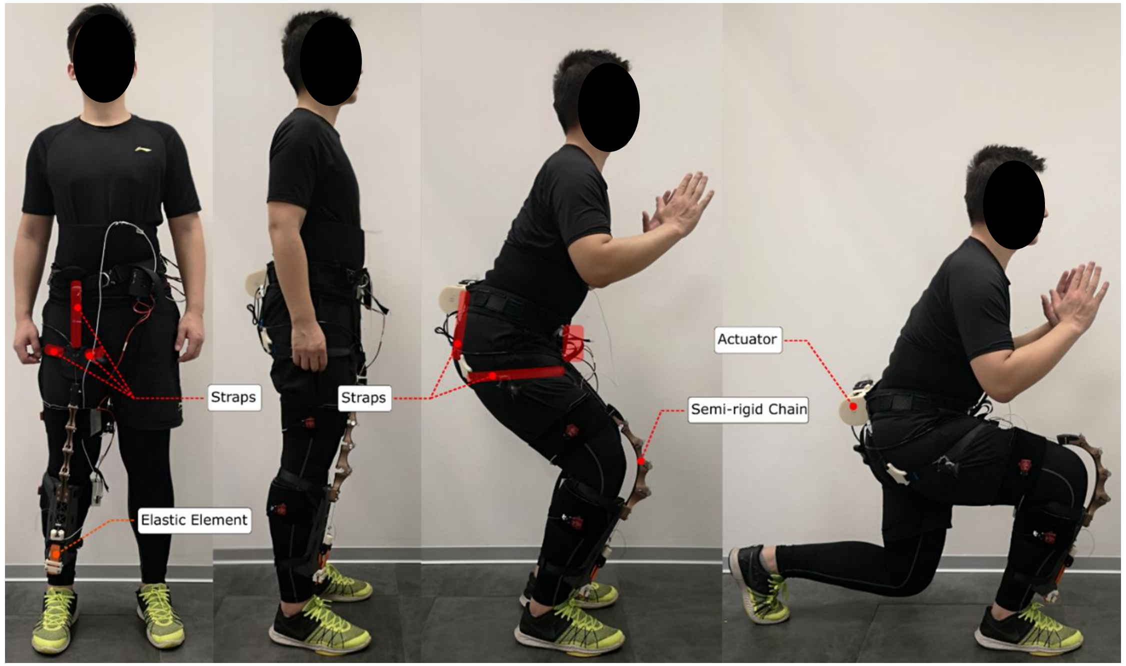
T10.2: SOPHIA exploitable results

#12 Exo-Muscle knee assistive device

Back to overview

Description/Contents:

- Semi-rigid chain mechanism
- Deterministic tendon routing & load compensation functionality, based on transformation of chain mechanism to rigid structure
- Elimination of parasitic forces and constraints caused by misalignment due to the translation of knee joint rotation axis
- No direct contact/loading of the knee joint while providing the assistive functionality



Background knowledge:

- Series elastic actuation
- Tendon driven and lightweight

Lead partner: IIT

Involved partners: -

Work Package: WP8

Exploitation channel:

- Licensing to companies and/or spin-offs

TRL 5

Current status & next steps:

- System designed and tested on multiple subjects
- MPC controller developed and tested

T10.2: SOPHIA exploitable results

#13 Elbow Assistive Device

Back to overview

Description/Contents:

- A novel actuation system based on cam-spool mechanism.
- Cable-driven approach to force transmission.
- Human elbow torque/angle profile.
- Lightweight design.
- Easy donning/doffing with the help of adaptive elements.
- Energy storage material in the actuation system.

Background knowledge:

- Series elastic actuation
- Tendon driven and lightweight

Lead partner: IIT

Involved partners: -

Work Package: WP8

Exploitation channel:

- Licensing to companies and/or spin-offs

TRL 5

Current status & next steps:

- Prototype designed and tested
- Validated on multiple subjects
- PoC tests done in HIDRIA use-case

T10.2: SOPHIA exploitable results

C. Human Modeling Software & Simulation

T10.2: SOPHIA exploitable results

#14 HRI30: An Action Recognition Dataset for Industrial HRI

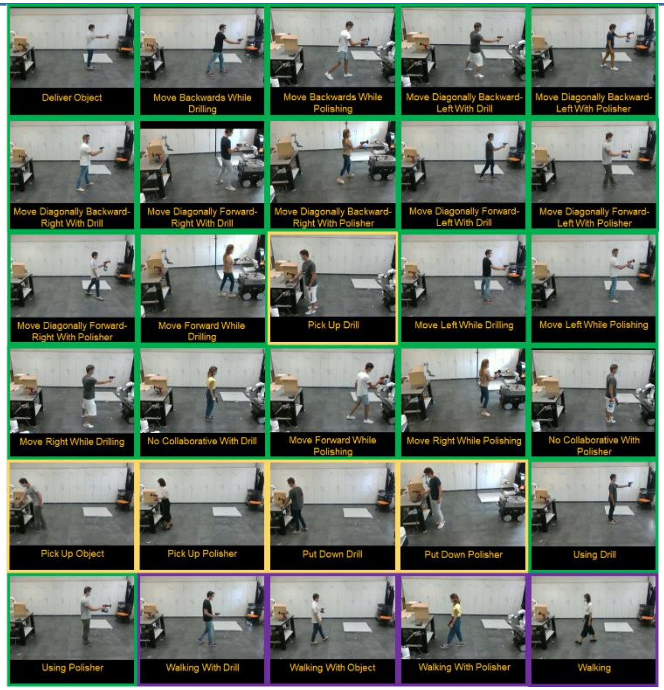
Back to overview

Description/Contents:

- HRI30 dataset containing 30 categories of industrial-like actions and 2.940 manually annotated clips.
- Tested on multiple action detection approaches and compare it with the HMDB51 and UCF101 public datasets using the best-performing approach.
- Dataset will encourage research towards understanding actions in collaborative industrial scenarios.

Background knowledge:

- State of the art survey of existing industrial activities datasets.



Lead partner: IIT

Involved partners: IIT

Work Package: WP5

Exploitation channel:

- Open source licenses

TRL 4

Current status & next steps:

- Tested, validated and ready to be exploited

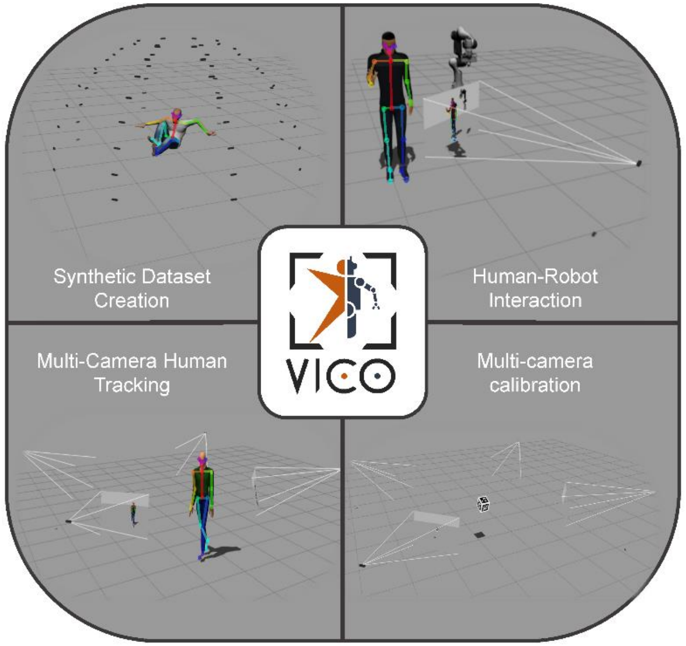
T10.2: SOPHIA exploitable results

Back to overview

#15 Open-VICO: Open-Source Gazebo Toolkit for Vision-Based Skeleton Tracking in HRC

Description/Contents:

- Open-VICO, an open-source toolkit to integrate virtual human models in Gazebo focusing on vision-based human tracking.
- Open-VICO allows to combine realistic human kinematic models, multi-camera vision setups, and human-tracking techniques in the same simulation environment along with numerous robot and sensor models.
- The possibility to incorporate pre-recorded human skeleton motion with Motion Capture systems broadens the landscape of human performance behavioral analysis within Human-Robot Interaction (HRI) settings.



Background knowledge:

- Camera calibration theory
- Open-source skeleton tracking state of the art survey.

Lead partner: IIT

Involved partners: IIT

Work Package: WP5

Exploitation channel:

- Open source licenses

TRL 4

Current status & next steps:

- Tested, validated and ready to be exploited

T10.2: SOPHIA exploitable results

#16 Worker Capture System

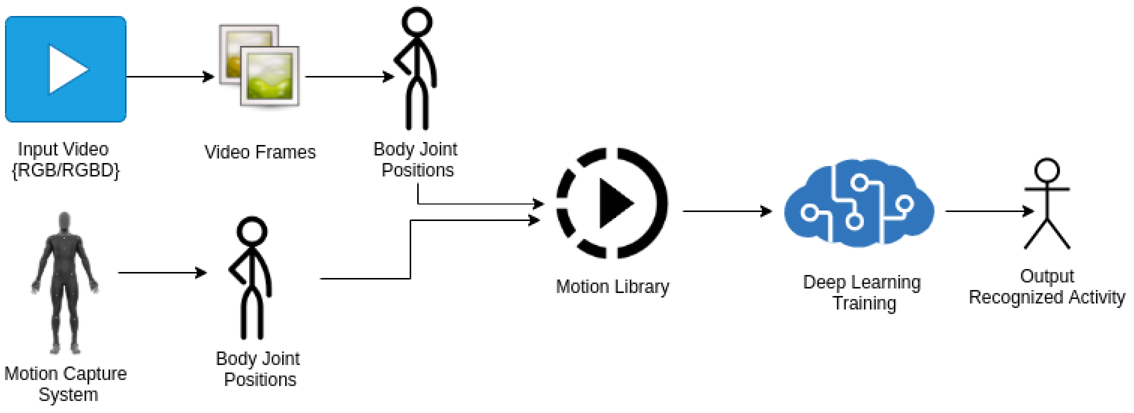
Back to overview

Description/Contents:

- Motion Library to improve human tracking and to output joints angles, velocities and accelerations.
- Activity recognition system to recognize activities using the motion library outputs.
- Extensible to various 3D human skeleton extractors (openpose interface is provided).
- Extensible to various sensors (RGBD, motion capture); kinect2 interface, ROS interface, RGBD image streams and Xsens data streams are provided,

Background knowledge:

- RGB-D stream based real time hand gesture recognition system.
- Human kinematic modeling and computation



Activity Recognition Process Flow

Lead partner: UM

Involved partners:

Work Package: WP5

Exploitation channel:

- Open-source software framework
- Extensions for interfacing commercial/non-free systems

TRL 4

Current status & next steps:

- https://gite.lirmm.fr/humar/applications/pipeline_identification
- Improvements, documentation and debugging are ongoing

T10.2: SOPHIA exploitable results

#17 Human action/activity dataset

Back to overview

Description/Contents:

- Redefined standards to explain/distinguish motion, action and activities.
- Designed a dataset with respect to the new definitions.
- Built an RGB-D activity dataset to test activity recognition solutions and release it as open-source dataset.

Data structure

In this table we define fourteen (14) actions to be recognized by the robot.

Actions	MOTION TYPE	DESCRIPTIONS	Occlusions	Light/Dark
Standing	idle	stand straight with your feet	O/F	l/d
Bend down	Action	reduce the distance between the head and the feet on the ground	O/F	l/d
Stand up	Action	Increase the distance between the hand and the feet on the ground	O/F	l/d
Crouch	Action	Knee outside the chest axis and the foot pelvis distance lower than the knee pelvis distance	O/F	l/d
Sit	Action	Knee outside the chest axis and the foot pelvis distance higher than the knee pelvis distance	O/F	l/d
Stop sign	Gesture	right hand on the left shoulder and left hand on the right shoulder	O/F	l/d
Come sign with both hands	Action	Hand-foot angle at 45 degrees from the horizontal and hand-shoulder distance going back and forth	O/F	l/d
Come sign with right hand	Action	Hand-foot angle at 45 degrees from the horizontal and hand-shoulder distance going back and forth	O/F	l/d
Come sign with left hand	Action	Hand-foot angle at 45 degrees from the horizontal and hand-shoulder distance going back and forth	O/F	l/d
Walk	Action	Moving by successive movements of the legs and keeping contact with the floor	O/F	l/d
Reach with both hands	Action	Simultaneous movements of both hands reaching out and then returning to the body	O/F	l/d
Reach with left hand	Action	left hand reaching out and then returning to the body	O/F	l/d
Reach with right hand	Action	right hands reaching out and then returning to the body	O/F	l/d
Hold with both hands	Action	Constant distance between both hands and fixedposition of both hands between the pelvis and the shoulders	O/F	l/d

Background knowledge:

- State of the art survey of existing action and activity recognition datasets and definitions.

Lead partner: UM

Involved partners:

Work Package: WP5

Exploitation channel:

- Open dataset for activity recognition

TRL 4

Current status & next steps:

- Methodology has been described
- Dataset produced.
- Released : July 22.

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#18 Enhanced HRC functions for ema simulation

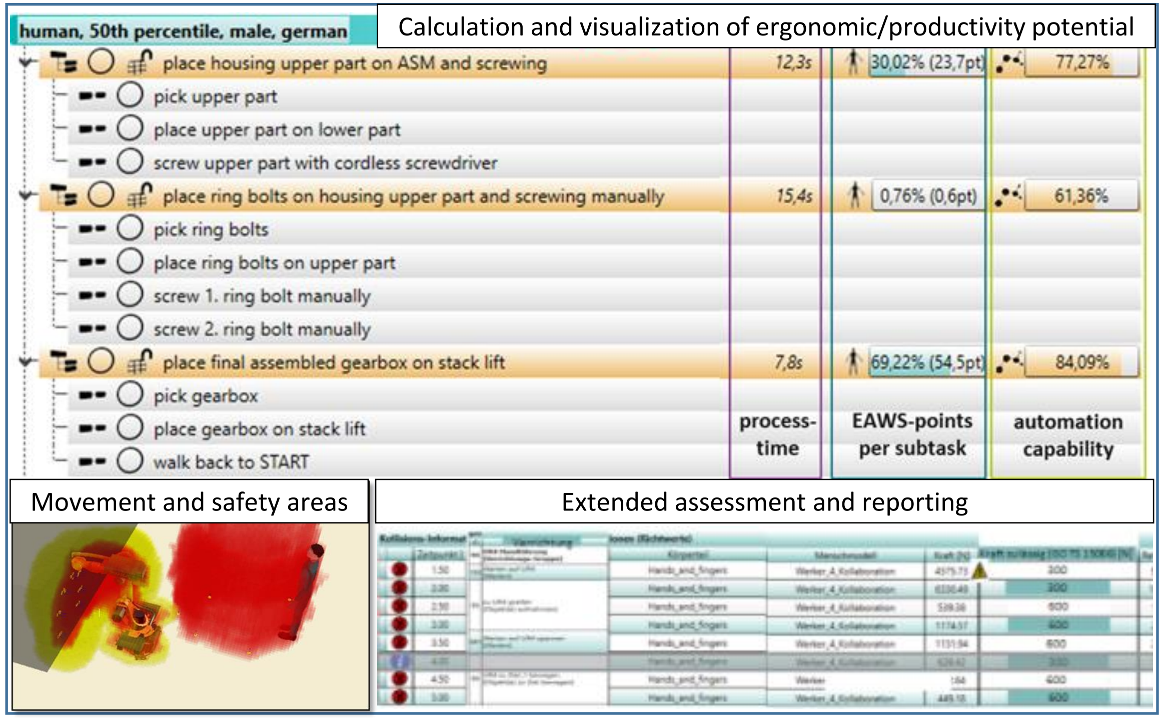
Back to overview

Description/Contents:

- Import of quick check results to ema, for multiple work stations
- Calculate and show ergonomic and productivity potential for each sub-task of the work process simulation (see figure 1)
- Add new cobots and related equipment / SOPHIA technologies to resources library (e.g. UR16e, Robotnix mobile platform)
- Update and enhance integrated safety check and HRC report with additional standards and key performance indicators

Background knowledge:

- ema Software Suite with integrated module for robot/cobot concept planning and assessment developed by IMK



Lead partner: IMK

Involved partners: IIT, DIN to provide data on technology & standards

Work Package: WP2, WP10

Exploitation channel:

- Integration in ema Work Designer as a separate HRC module (commercial software distributed by IMK)

TRL 8

Current status & next steps:

- Concepts have been described
- Software development ongoing
- Software module released in 10-2023

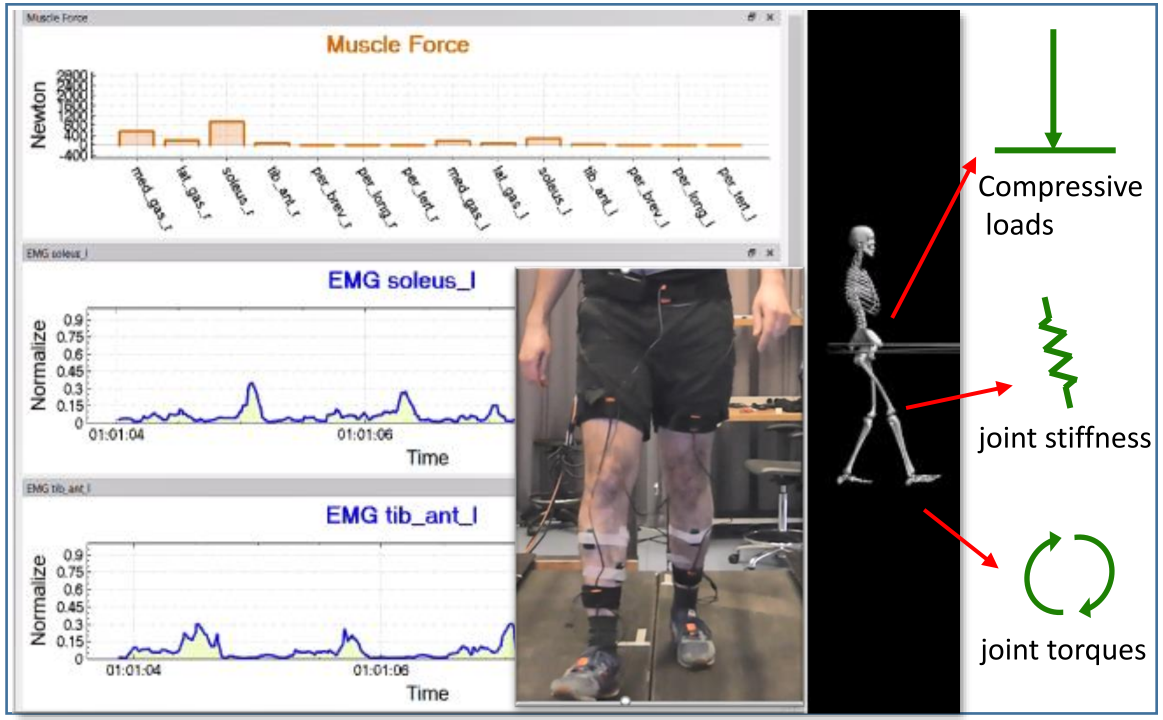
T10.2: SOPHIA exploitable results

#19 Real-time human musculoskeletal modelling

Back to overview

Description/Contents:

- Compute real-time muscle-level inner states and joint level kinetics in human movements.
- Use electromyography sensors (EMGs) to get muscle excitations and serve as model-driven inputs.
- New framework of ergonomic evaluation, rapid haptic feedback, and human robot interactions, with considering the muscle level states.



Background knowledge:

- Real-time human musculoskeletal modelling using EMG data incl. user-specific modelling calibration toolbox (CEINMS-RT)

Lead partner: UT

Involved partners: -

Work Package: WP2

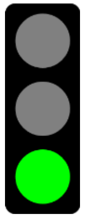
Exploitation channel:

An open source software for bio-feedback applications (e.g., rehabilitation) or control of assistive devices or haptic feedback, that can be licensed to third parties or as the main outcome of a spin-off company.

TRL 6

Overall takeaways:

- Integration across work packages to enable haptics or assistive systems
- Open-access software release in preparation



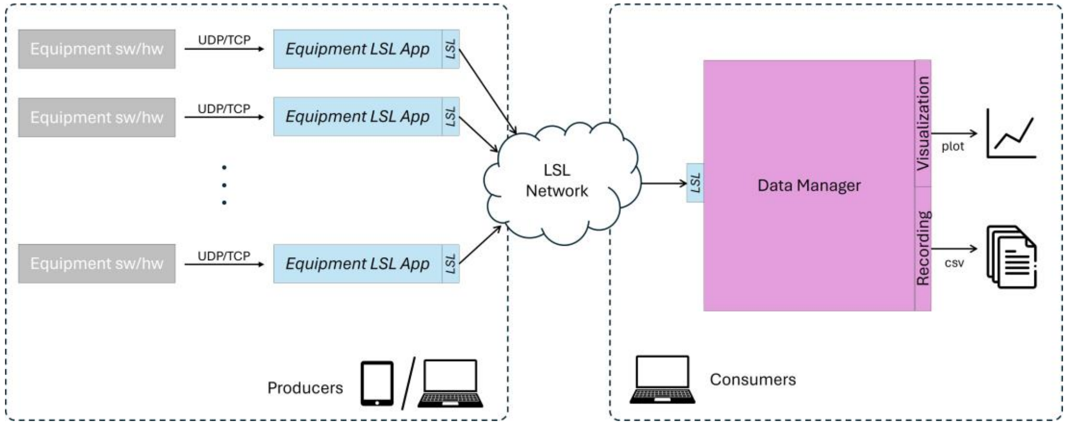
T10.2: SOPHIA exploitable results

#20 Framework for Multi-Modal Physiological Sensing

Back to overview

Description/Contents:

- A Lab Streaming Layer (LSL) package that integrates data from multi-modal physiological sensors such as the Vicon Motion Capture, Xsens, Cometa EMG, Kistler force plates
- Realtime data visualization and capturing using a 2D interface developed in the Unity engine.
- Recording and saving of synchronized sensor measurements.



Background knowledge:

- Existing codes developed by the partners
- Lab Streaming Layer

Lead partner: VUB

Involved partners: -

Work Package: WP6

Exploitation channel:

- Open source licenses
- IEEE RAM tutorial publication

TRL: 5

Current status & next steps:

- Concepts have been described
- Software development is finished
- Tutorial is currently under creation

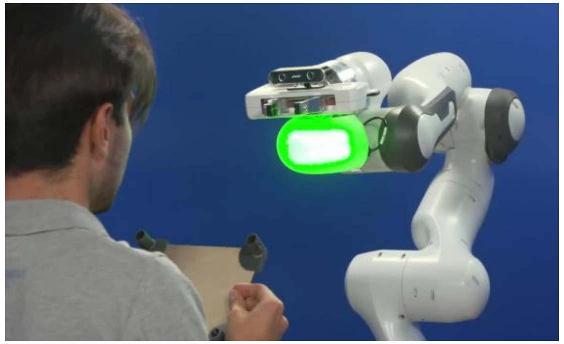
T10.2: SOPHIA exploitable results

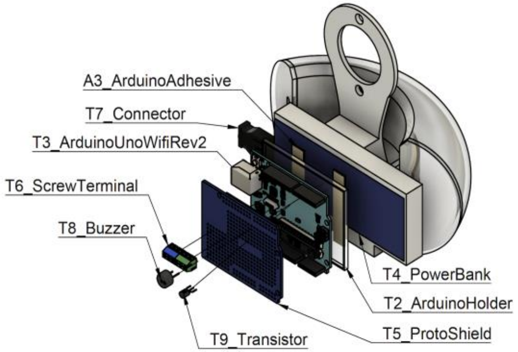
#21 Antropo: social communication interface

Back to overview

Description/Contents:

- An open-source platform to increase anthropomorphism of cobot for robot-to-human communication
- Visual and audio feedbacks are combined with human-like gesture of cobot
- Developed for Franka robot and can be customized to other robots e.g. UR
- Controlled by ROS and Wifi





Background knowledge:

- Human-robot interaction and collaboration
- Arduino, ROS

Lead partner: VUB

Involved partners: -

Work Package: WP6

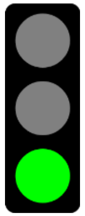
Exploitation channel:

- Open-source hardware and software
- Open access publication

TRL: 5

Current status & next steps:

- Hardware and software: validated
- Open-source platform: registered
- Open access publication: published



T10.2: SOPHIA exploitable results

D. Methods, Tools & Standards

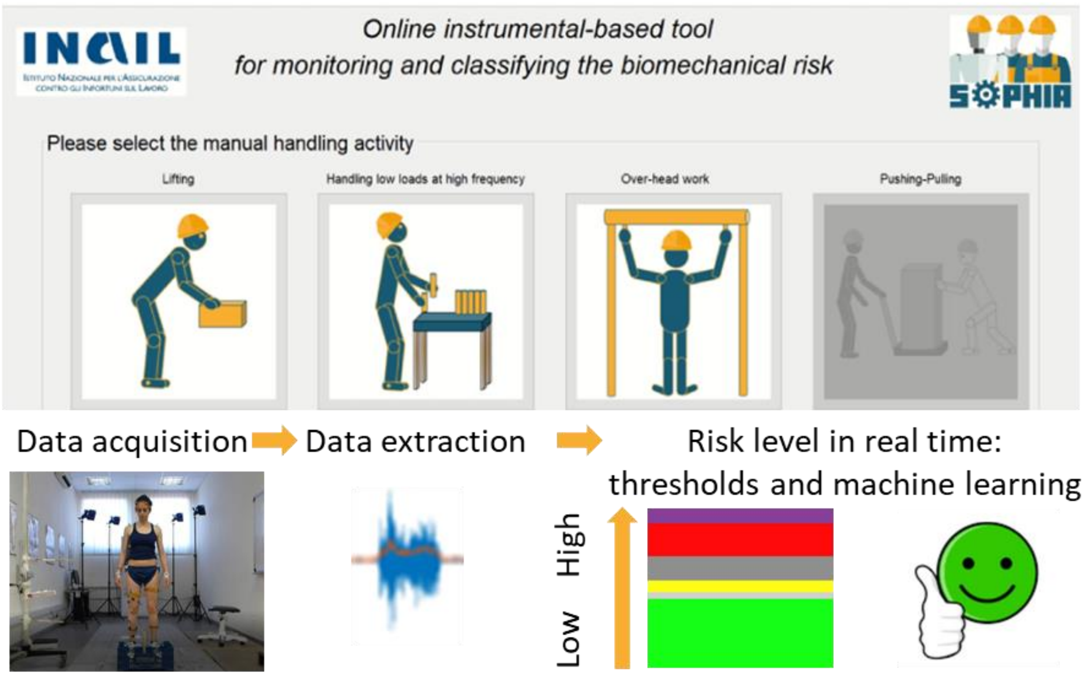
T10.2: SOPHIA exploitable results

#22 Instrumental-based tool for monitoring/classifying biomechanical risk

Back to overview

Description/Contents:

- A software package to monitor and classify the biomechanical risk in the workplace.
- The method consists of objective measures (kinematics, kinetic and electromyographic) of workers during the manual handling activities.
- Using the tool, the company receives online personalized advice on the biomechanical risk.



Background knowledge:

- Biomechanical risk assessment methods.
- Human data analysis.
- Software development.

Lead partner: INAIL

Involved partners: UT, VUB

Work Package: WP3

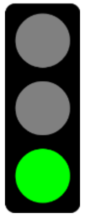
Exploitation channel:

- Eventually software license
- Companies can hire us to do a risk assessment

TRL 6

Current status & next steps:

- Concepts have been described
- Software development is finished
- Tested



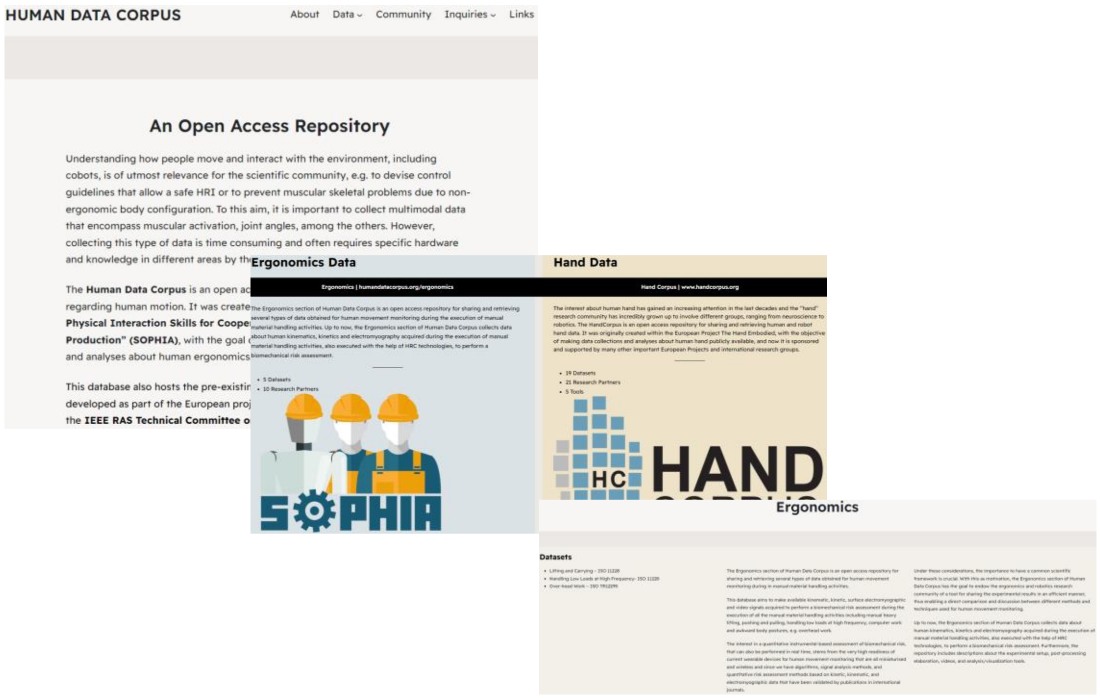
T10.2: SOPHIA exploitable results

#23 Human Ergonomics Database

Back to overview

Description/Contents:

- Human ergonomics database with kinematic and dynamic sensory data.
- The database will be used to train predictive machine-learning algorithms to improve recognition of biomechanical risks.
- The database will be made available as open source.



Background knowledge:

- Existing biomechanical data acquired by the partners during working activities.

Lead partner: INAIL

Involved partners: IIT, UNIPI

Work Package: WP3

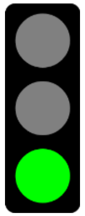
Exploitation channel:

- Open Access repository for sharing and retrieving human ergonomic data
- Publication in high-impact journal

TRL 8

Current status & next steps:

- Concepts have been described
- Web domain has been bought
- Database developed and published (https://humandatacorpus.org/)



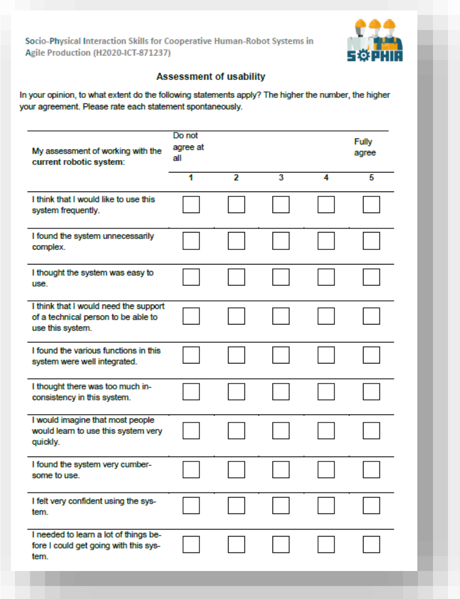
T10.2: SOPHIA exploitable results

#24 Questionnaire to evaluate the dialog design of HRI systems

Back to overview

Description/Contents:

- Validated detailed questionnaire to assess different aspects of dialogue design of HRI systems: suitability for the task, self-descriptiveness, controllability, conformity with user expectations, error tolerance, suitable for individualization, suitability for learning as well as user engagement.
- Items are based on the design guidelines of the ISO 9241-110.

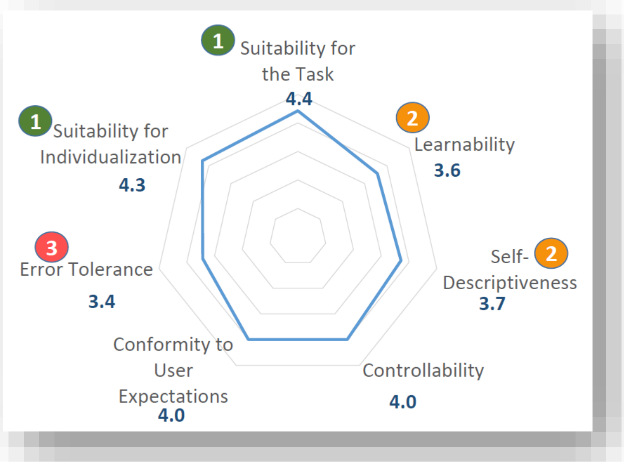


Socio-Physical Interaction Skills for Cooperative Human-Robot Systems in Agile Production (H2020-ICT-871237)

Assessment of usability

In your opinion, to what extent do the following statements apply? The higher the number, the higher your agreement. Please rate each statement spontaneously.

My assessment of working with the current robotic system:	Do not agree at all 1	2	3	4	Fully agree 5
I think that I would like to use this system frequently.	☐	☐	☐	☐	☐
I found the system unnecessarily complex.	☐	☐	☐	☐	☐
I thought the system was easy to use.	☐	☐	☐	☐	☐
I think that I would need the support of a technical person to be able to use this system.	☐	☐	☐	☐	☐
I found the various functions in this system were well integrated.	☐	☐	☐	☐	☐
I thought there was too much in-consistency in this system.	☐	☐	☐	☐	☐
I would imagine that most people would learn to use this system very quickly.	☐	☐	☐	☐	☐
I found the system very cumber-some to use.	☐	☐	☐	☐	☐
I felt very confident using the sys-tem.	☐	☐	☐	☐	☐
I needed to learn a lot of things be-fore I could get going with this sys-tem.	☐	☐	☐	☐	☐



Background knowledge:

- Results on human-robot interaction quality from other research projects in this field.

Lead partner: BAuA

Involved partners: -

Work Package: WP1

Exploitation channel:

- Open Access Publication

TRL: N/A

Current status & next steps:

- Items and questionnaire developed
- Survey completed with initial sample
- Specific design requirements derived

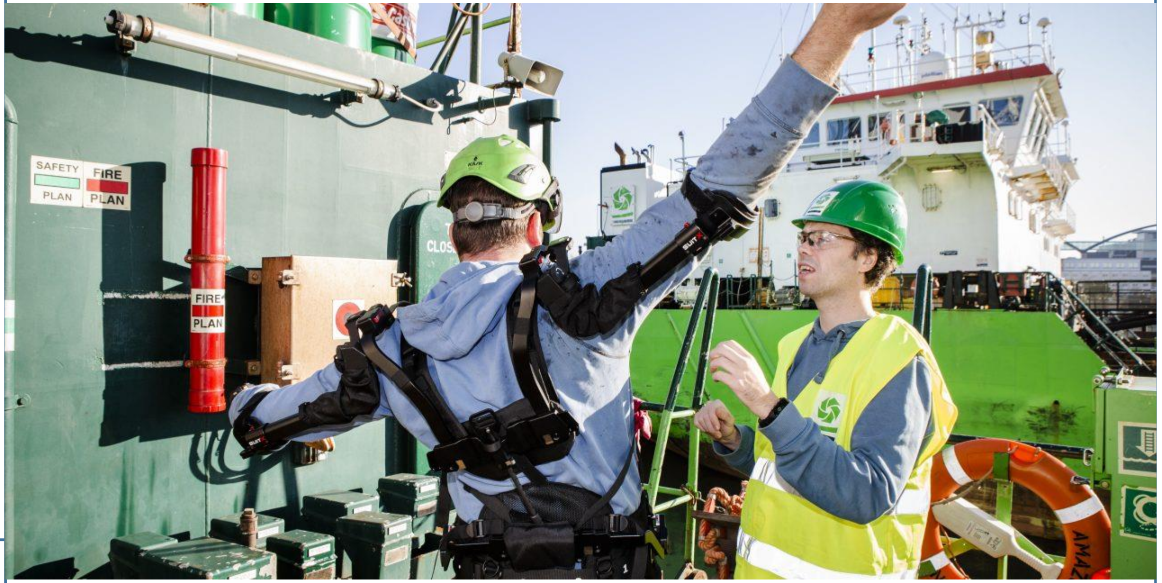
T10.2: SOPHIA exploitable results

#25 Exoskeleton acceptance & suitability assessment

Back to overview

Description/Contents:

- A methodology to assess the acceptability of (commercially available exoskeletons) and its effectiveness in companies.
- The method consists of subjective measures (survey questions) as objective measure (kinematics, (electro-)(psycho-) physiological measures) and workshops in which exoskeletons can be tried on.
- After applying the methodology and analyzing the data, the company receives personalized advice on the implementation and suitability of a selection of exoskeletons.



Background knowledge:

- Existing methods and codes developed by the partners

Lead partner: VUB

Involved partners:

Work Package: WP1 & WP9

Exploitation channel:

- Provide consultancy services to companies and other organizations

TRL: N/A

Current status & next steps:

- Methodology has been described
- Service is available for companies

T10.2: SOPHIA exploitable results

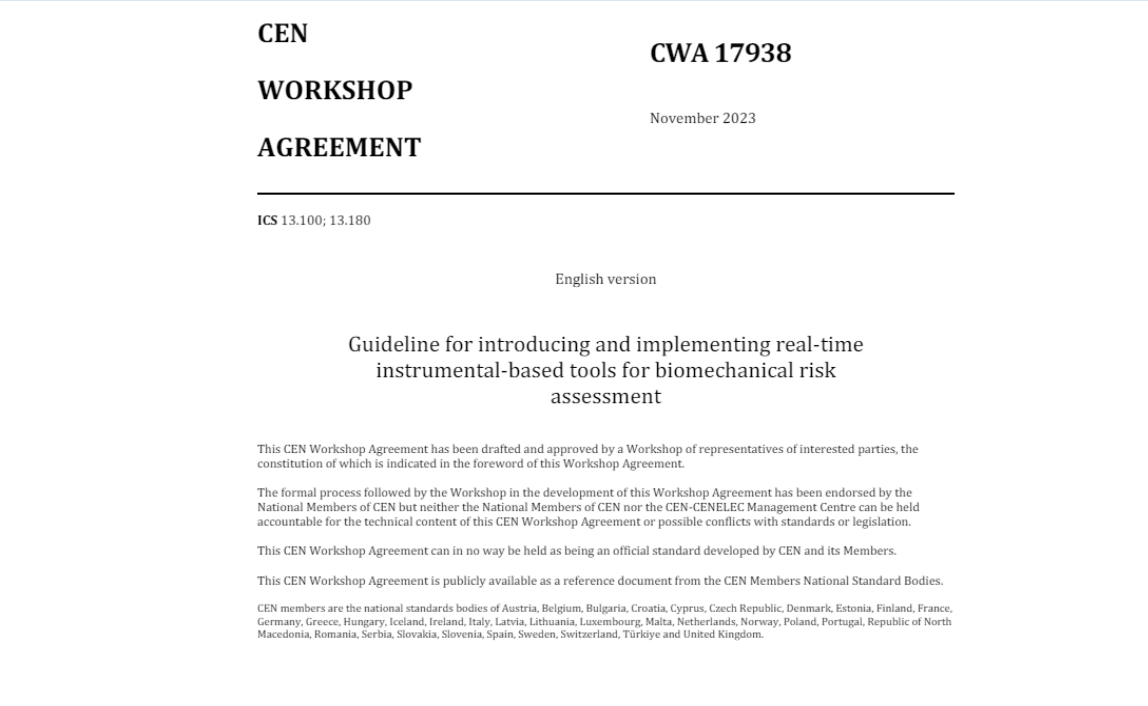
#26 Standardisation document(s) on HRC and biomech. assessment

Back to overview

Description/Contents:

- Establish a common ground, determine rules or guidelines, create conformity and order by defining requirements and is based on the principle of consensus or majority decision
- CWA is an option to promote the project results to the market
- Possible topics identified in SOPHIA project:
  - Biomechanical risk assessment
  - Communication among wearables
  - Digital Human modelling
  - Human-robot collaboration

Background knowledge: ---



CEN WORKSHOP AGREEMENT

CWA 17938

November 2023

ICS 13.100; 13.180

English version

Guideline for introducing and implementing real-time instrumental-based tools for biomechanical risk assessment

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which is indicated in the foreword of this Workshop Agreement.

The formal process followed by the Workshop in the development of this Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN-CENELEC Management Centre can be held accountable for the technical content of this CEN Workshop Agreement or possible conflicts with standards or legislation.

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Lead partner: DIN

Involved partners: INAIL, IIT, BAuA, UP, VUB, UM, IMK

Work Package: WP10

Exploitation channel:

- publication of CWA 17938 (CEN Workshop Agreement)

TRL: N/A

Current status & next steps:

- Active liaison with ISO TC 159/SC3/WG4
- publication of CWA 17938 on biomechanical risk assessment completed

Socio-Physical Interaction Skills for Cooperative Human-Robot Systems in Agile Production

H2020-ICT2019-2
(GA 871237)

For more information about SOPHIA project,
please visit: https://project-sophia.eu/

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