CENTAURO

Objectives:

Versatile Robot Platform:
Flexible and highly articulated robot to support different modes of locomotion and manipulation. A base with four legs ending in wheels, anthropomorphic upper body, with two 7-DOF arms, movable sensor head.

Robust Mobility:
Able to navigate in affected man-made environments, combining legged and wheeled locomotion.
Dexterous Manipulation:
By telemanipulation unmodified human tools can be used to solve bimanual manipulation tasks.

Intuitive Control:
A full-body telepresence suit allows for intuitive control by the human operator.

Situation Awareness:
Robot sensors provide necessary awareness of the situation supported by augmented virtual reality.

Virtual Testbed:
A physics-based simulation of the robot and its environment allows for verification of navigation and manipulation plans.

Evaluation Methodologies:
Systematic benchmark scenarios and performance measures guided by the end-user requirements.

Implementation Plan:

Develop and Test of the Robot Platform:
- Design and fabricate the mechatronic components.
- Joint and task space level control strategies.
- Walking and balancing strategies for wheel and leg functions.
- Validate the CENTAURO platform and the control strategies.

Development of the Operator Interfaces:
- Dual arm and hand exoskeleton with force feedback.
- Bilateral control strategy for robust teleoperation of the robot for navigation and manipulation
- Main operator audio-visual display with VR overlay.
- Support operator station with a third-person perspective.

Develop a Virtual Testbed for Modeling & Simulation:
- Visualization and simulation of the robot and its environment.
- Central world model (CWM) a central data basis.
- Virtual model of the CENTAURO robot and its environment, with rigid body dynamic-, actuator-, and sensor-simulation.
- Predictive model of the robot to evaluate possible actions.

Develop Methods for Robust Mobility & Navigation:
- Method for modeling space for navigation in rough terrain.
- Online method for terrain classification for locomotion.
- Methods for full-body navigation planning in mixed terrain exploiting wheeled and legged locomotion.
- Autonomous & semi-autonomous navigation in rough terrain.

Develop Single- and Dual-Arm Manipulation:
- Perception for bottom-up scene segmentation into objects.
- Dynamic collision-avoiding whole-body motion control.
- Grasp and motion planning for single-arm object pick & place.
- Grasp learning from human demonstration (telemanipulation).
- Autonomous execution of grasp and motion plans.

System Design and Continuous Integration:
- Overall technical and software system architecture.
- Design communication link between robot and control station.
- Integrate core components: robot, simulation, control station.
- Integration of Centauro disaster-response system

Requirement Specification & Evaluation:
- Requirements and specifications for the whole system and individual components from the evaluation perspective.
- Evaluation of integrated Centauro disaster-response system.