Progetto BISTOURY

3D-guided roBotIc Surgery based on advanced navigaTiOn systems and aUgmented viRtual reality

11-12-2024

Consortium description

Coordinator: Campus Bio-Medico University of Rome (UCBM)

UCBM is a private academic institution that will rely on the strong experience of the involved research units, i.e. Advanced Robotic and Human Centred Technologies (CREO - website) and Computer Systems and Bioinformatics (CoSBi - website), to carry out the project activities.
CREO unit, led by Loredana Zollo, has a solid background in the fields of biomedical robotics, biorobotics and biomechatronics, and develops robotic and mechatronic technologies for customized human-robot interaction.
CoSBi, led by Paolo Soda, specializes in intelligent data analysis for industrial and biomedical applications. Research areas include signal processing, artificial intelligence, multi-parameter and multimodal analysis, and explainable AI.

Partner: Teleconsys SpA

Teleconsys is an innovative SME operating to support the digitalization of businesses and PAs. The company adopts the Open Innovation model and offers systems integration, application development and cybersecurity services, designing and implementing innovative solutions. Currently, Teleconsys is focusing on Web 4.0 technologies and in particular on DLT (especially on direct acyclic graph technologies), Generative AI, xR & metaverse and on the creation of computing algorithms suitable for quantum computing.

Partner: Campus Bio-Medico University Hospital Foundation (FPUCBM)

The Urology Department at FPUCBM is a specialized team focused on minimally-invasive procedures and precision medicine. Since October 2022, the team has integrated robotics, particularly the Hugo™ RAS System, into practice to elevate treatment standards. The team's robust background in minimally invasive surgery extends to active contributions in the development and application of the Hugo™ RAS System, fostering a deep understanding of its application in diverse surgical contexts. In precision medicine, the research initiatives target personalized interventions, aligning with our commitment to tailoring medical treatments to individual characteristics.

Project overview
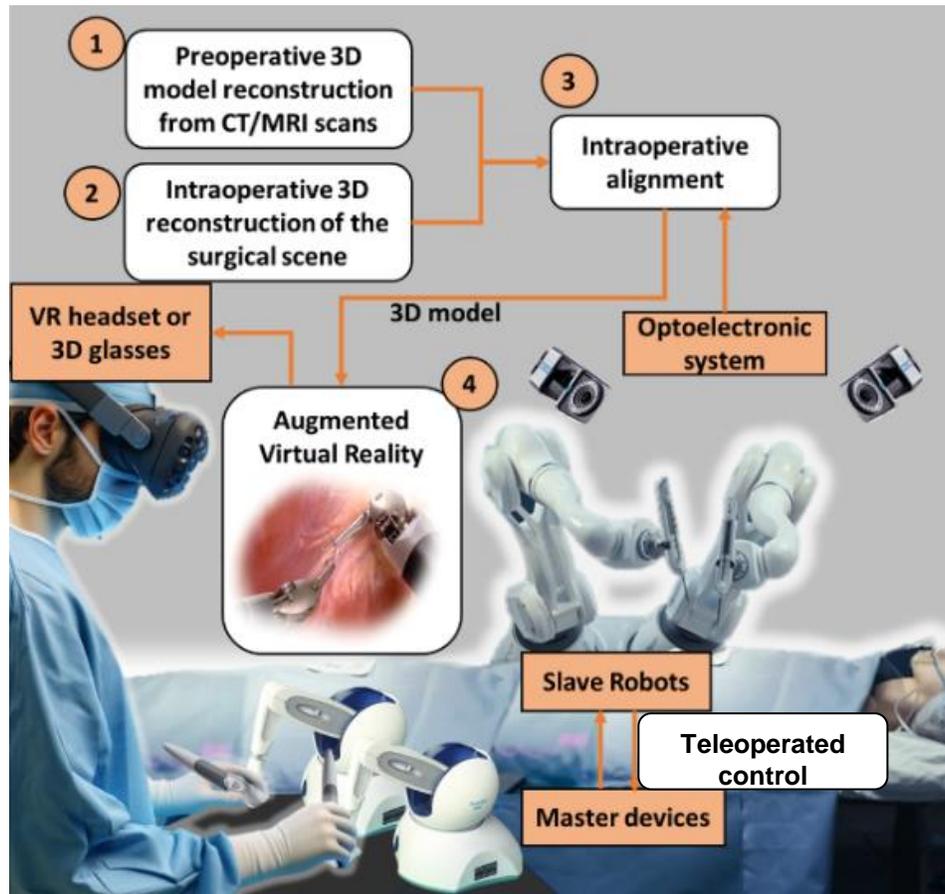
Project title
BISTOURY - 3D-guided ro**B**ot**I**c **S**urgery based on advanced naviga**T**i**O**n systems and a**U**gmented vi**R**tual realit**Y**

Spoke N. 2 - Intelligent Health

Topic 3 - Developing AI techniques for augmented reality in robotic surgery

General objective:
BISTOURY proposes an integrated system based on MIRS, Augmented Virtual Reality (AVR) and a new pipeline of AI methods which provide surgeons with

1. **enhanced perception of the anatomical structures** through the combination of visual instructions and/or haptic feedback
2. **intraoperative support to the surgeon's decision-making and guidance** for navigation into the anatomical structures.

Project duration
- **Inizio progetto:** 01/06/2024
- **Fine progetto:** 31/08/2025
- **Durata complessiva:** 15 mesi
- **Budget totale:** 325.959,21 €

Contribution to the Spoke research program

SPOKE 2: Intelligent health Topic 3: expected outcomes	How BISTOURY addresses the Spoke expected outcomes through Specic objectives (SO)
1. Enhanced creation of case-specific 3D virtual models	**SO1 -** To improve accuracy in the 3D reconstruction of a functional non-static preoperative 3D model of the patient **SO3 -** To Enhance Surgical Simulation and Data Security: Developing Advanced GAN Models with Comprehensive Quality Assessment and Robust Privacy Preservation
2. Advanced AI-based intraoperative registration	**SO2** - To propose advanced AI methods for improved intraoperative 3D reconstruction of the surgical scene and automatic alignment to the preoperative model of the patient
3. Comprehensive AR software based on preoperative imaging	**SO4** – To improve the surgeon's perception of the anatomical structures during surgery (through Augmented Reality) and enhance navigation performance through the anatomical structures **SO5** – To demonstrate compatibility of the proposed approaches with a MIRS platform and validate it on cadavers

Contribution to the HEAL ITALIA Program

- **Promotion of 4.0 technologies in Precision Medicine**: The project aligns with HEAL ITALIA's goals by integrating advanced robotics, artificial intelligence, and augmented reality to enhance surgical accuracy and reduce errors.

- **Public-private collaboration**: It fosters partnerships among universities, companies, and clinicians, meeting HEAL ITALIA's aim of interdisciplinary collaboration that combines technical and clinical expertise.

- **Reducing territorial disparities:** Contributes to technological development and addresses territorial disparities through tele-operated surgery, enabling specialized surgeons to perform advanced procedures across multiple locations, including remote areas. This approach expands access to cutting-edge surgical care, ensuring that patients in underserved regions benefit from expert interventions.

- **Increase in Technology Readiness Level (TRL)**: The project advances technological maturity from TRL 3 to TRL 4-5, supporting HEAL ITALIA's objective of bridging research and industrial/clinical application.

Contribution to Precision Medicine

- **Reduction of surgical errors**: Implements AI solutions to enhance preoperative and intraoperative accuracy, reducing the margin for anatomical recognition errors.

- **Personalization of care**: Develops 3D patient models for more targeted and patient-specific surgical planning.

- **Advanced clinical data management**: Deploys technologies for secure handling and processing of surgical data, ensuring GDPR compliance and improving the quality of clinical datasets.

- **Adoption of innovative technologies**: Integrates robotic platforms and augmented reality to improve intraoperative visualization and support clinical decision-making.

- **Measurable outcomes**: Demonstrates compatibility with real clinical platforms and conducts tests on cadavers to validate the technologies in relevant environments.