

SMart weArable Robotic Teleoperated surgery

Newsletter #1



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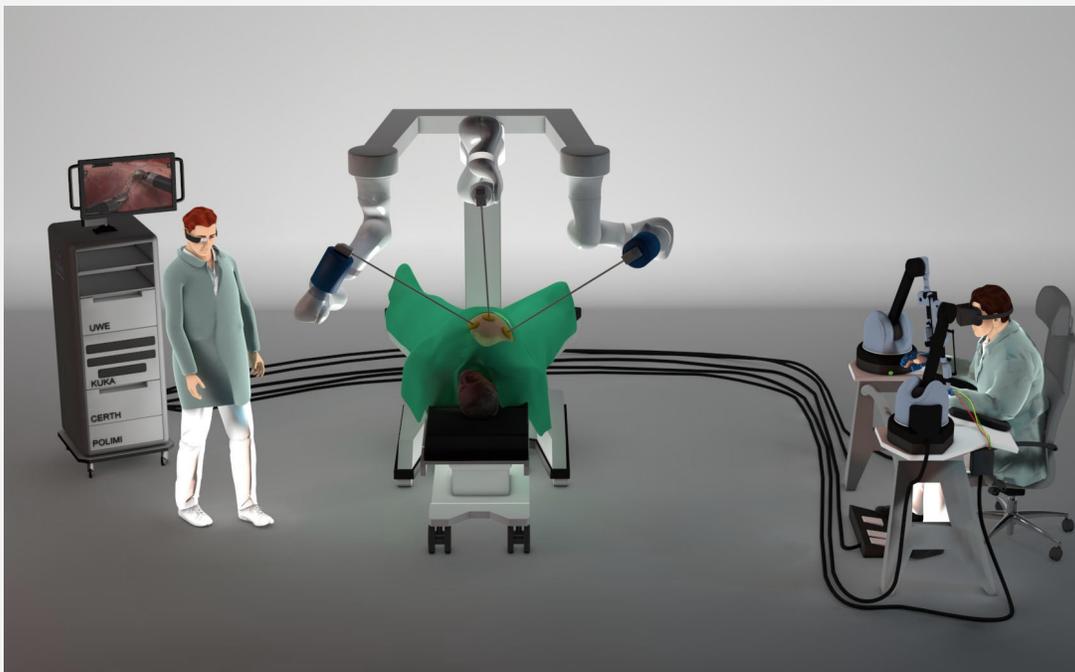
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SMARTsurg vision

The main vision of the SMARTsurg project is to enable complex minimally invasive surgical operations by developing a novel robotic platform for assisting the surgeon in such tasks. Advanced features will be developed and integrated into the proposed platform including:

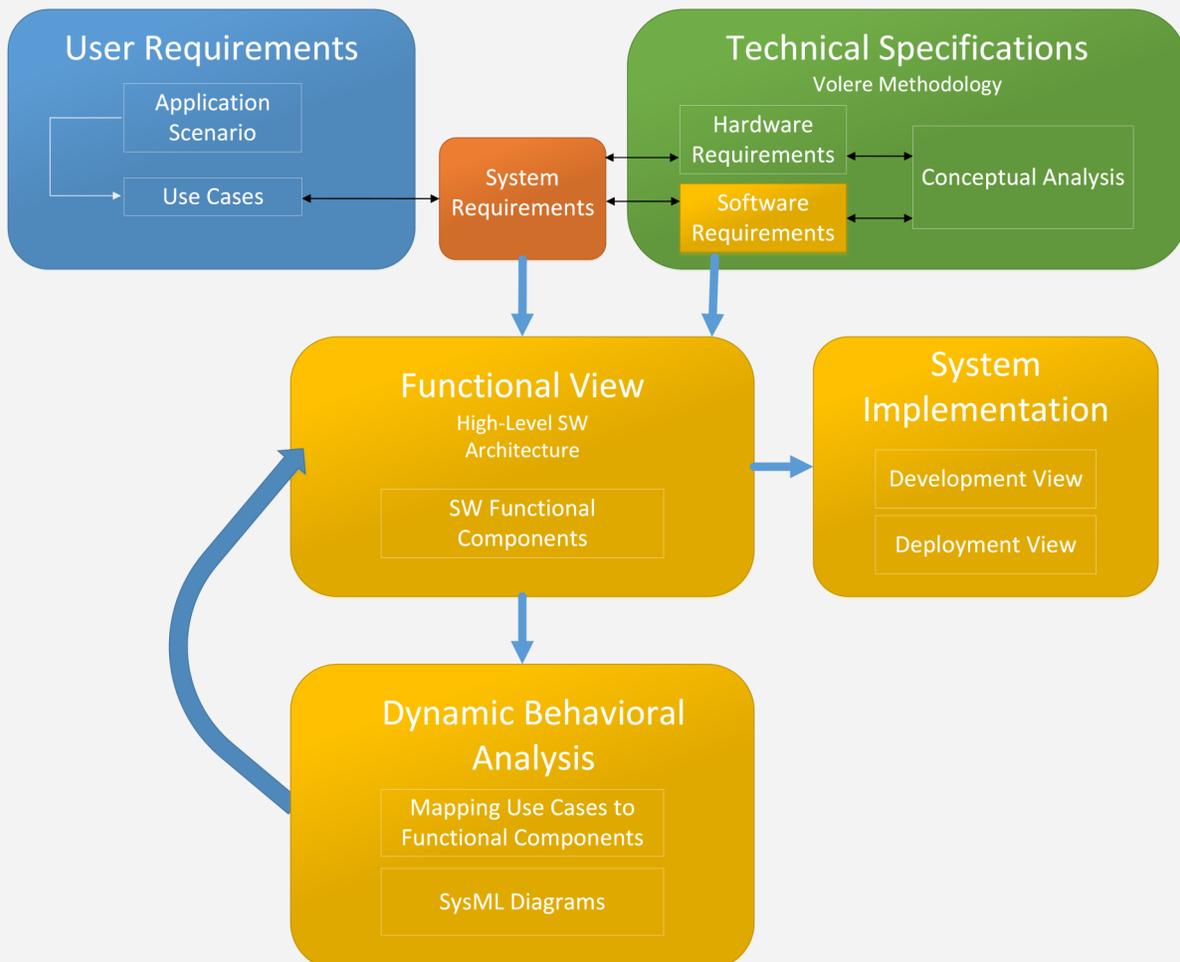
- Wearable surgical system to provide natural usability and high dexterity to allow the undertaking of more complex surgical procedures and to reduce the surgeon's cognitive load.
- Anthropomorphic multi-fingered surgical instrument controlled by the anthropomorphic wearable system, enabling user-centred design and modifications by means of additive manufacturing.
- Software embedded visual and force augmentation for increased safety and dependability.
- Functionalities enhancing the system's cognition abilities and dependability, such as dynamic active constraints construction and enforcement, as well as user intention detection.

The project will develop an advanced system for performing Robot Assisted MIS to reduce the surgeon's cognitive load related to the system's operation to shorten training time and deliver accuracy, safety, reduced procedure time and expanded applicability. Objectives: a) dexterous anthropomorphic surgical instruments b) wearable hand exoskeleton with haptic feedback to control the surgical instruments, c) wearable smart glasses for augmented reality and 3D reconstruction of the surgical field.



Overall Conceptual Architecture

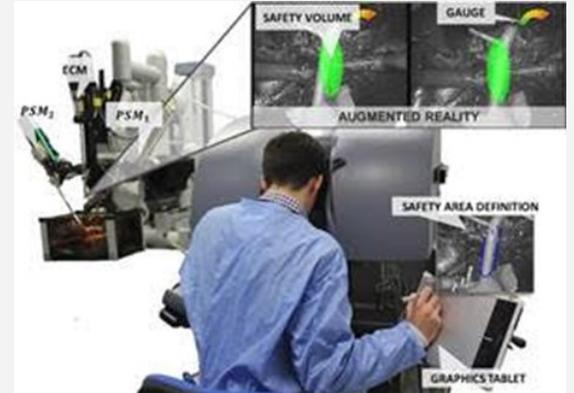
Overall conceptual architecture work performed includes an ongoing analysis of the state-of-the-art on relevant research projects, their similarities to SMARTsurg and their conceptual architecture. Moreover, several tele-conferences have been organised with consortium partners in order to discuss the system architecture and setting up a basic architectural concept that will be updated accordingly after the user requirements are analysed. Most functional components of the system have been identified and linked to specific tasks. A preliminary block diagram with these components and their interconnection has been designed, whereas initial correspondence between each block and the user requirements gathered by the actions has been defined. Using the results of end user requirements, use cases and application scenarios, the system specifications are extracted using the Volere methodology. The defined specifications will be used to further develop the high-level functional view of the architecture, whereas the selected use-cases will be employed for evaluating the system's functionality on a dynamic model using SysML Activity and Sequence diagrams.



Use Cases

SMARTSurg partners in line with Scientific and Technical objectives of the project and especially with the objective “To validate SMARTSurg project results in realistic scenarios involving procedures on different surgical domains” defined the following use cases:

1. Orthopaedic surgery:
 - a. Robot-assisted Partial Lateral Meniscectomy (RaPLM)
 - b. Robot-assisted Repair of Lateral Meniscus tear (RaLMR)
2. Cardiac surgery:
 - a. Operating/suturing a valve leaflet (OVL)
 - b. Suturing a small artery (SSA)
3. Urological surgery:
 - a. Robot-assisted cystectomy and intracorporeal reconstruction with ileal conduit or orthotopic neobladder (RARC)
 - b. Robot-assisted radical prostatectomy (RARP)
 - c. Robot-assisted partial nephrectomy (RAPN)



For each use case, a workflow has been created from the materials, together with iconographic information (pictures, drawings and videos) received from the clinical partners. To obtain user requirements in minimally invasive robotic surgery, Politecnico di Milano (POLIMI) and University of the West of England (UWE) interviewed non-expert and expert surgeons in Urology, Orthopaedic surgery and Cardiac surgery. POLIMI made available the DEIB daVinci research kit to the consortium, in order to allow surgeons to define pros and cons of this market dominating system with respect to the defined use cases. The DEIB daVinci research kit was also made available to test some of the system’s features (i.e. active constraints direct design on the visual field). A test has been also done on the DVRK by integrating the ‘Enhanced Vision System for Robotic Surgery’ (EnViSoRS), based on a user-defined Safety Volume (SV) tracking to minimize the risk of intraoperative bleeding. It aims at enhancing the surgeon’s capabilities by providing Augmented Reality (AR) assistance toward the protection of vessels (or damage sensible anatomical structures) from injury during the execution of surgical procedures with a robot.

European Robotics Forum 2017

In the frame of [European Robotics Forum \(ERF\) 2017](#) (March 22-24, 2017) SMARTsurg partners co-organized and participated to the following workshops:

- [ERF 2017 - Workshop on "Ethical Legal and Social Aspects of Healthcare Robotics"](#)

This ERF session brought together the three robotics and health related projects funded in the H2020 ICT-26 and ICT-25 Calls in April 2017: SMARTsurg, CYBERLEGS Plus Plus and MOVECARE. They cover three of the main aspects of health related robotics: rehabilitation, surgery and assisted living. All of them consider users (professional experts and beneficiaries) in the loop, therefore, raising regulatory issues and ELSA (Ethical, Legal and Social Aspects) related to the level of autonomy associated with the robotic system and the user interaction and perception of the service that such a system can provide. The end users discussion allowed to better tailor the objectives of the SMARTsurg project with respect to the basic requirements of cognitive robotics. The active constraints and pre-operative images superposition were recognized to be the most important topics.

The three projects, building on the previous experiences, are at the forefront of the research in the field, sharing ELSA considerations in the three paradigmatic health scenarios. Each scenario considers robotic systems acting with or inside the patient, the fact that raises issues and can delay the deployment and commercialisation process.

The above considerations have been widely examined and discussed in this workshop thanks to the participation of researchers, industrial partners, ELSA experts and healthcare experts (end users). The session was divided in short presentations addressing the healthcare needs and solutions proposed in the three projects (robot-assisted surgery, physiotherapy, augmentation of residual movement abilities, and assisted living), the issues related to the levels of autonomy in healthcare robotics and ELSA, and the barriers encountered by spin-offs in the field (regulatory aspects, clinical trials, EU vs. non EU competition etc.) followed by a round table open to the audience for discussion.



European Robotics Forum 2017



- [ERF 2017 - "Workshop on "Robotic surgery in the European researcher community: autonomous and semi-autonomous precision interventions"](#)

As showed during the Eurosurge project (<http://www.eurosurge.eu>), there is a great number of research centres/ universities dealing with autonomous and semi-autonomous surgical interventions around Europe. Eurosurge project launched the idea of creating a network for sharing development of common tools related to surgical robotics: now there exist platforms and shared repositories to effectively sharing research outcomes in order to speed up European research in the field. In this context, the objectives of this workshop were:

- ◆ to present on-going research activities in the field of robotic autonomous and semi-autonomous precision interventions, currently addressed by recently funded EU projects on surgical robotics themes
- ◆ to pave the way to a new generation of young researchers in this field
- ◆ to point out the challenges to be addressed on the near future from both the medical and the engineering point of view
- ◆ to create a network of young researchers to exploit next European funding opportunities in this field (e.g. Marie Curie actions and COST actions).

This last point also takes advantage of current European actions to connect researchers in the field of robotic surgery, such as the DVRK European community, which is currently taking common initiatives for sharing results on the application to the da Vinci robot.

The following H2020 EU projects on surgical robotics have been invited to present preliminary results on the research topics addressed [EurEyeCase](#), [EndoVespa](#), [EDEN2020](#), SMARTsurg and [MURAB](#).



Dissemination activities

- Sanja Dogramadzi and Antonia Tzemanaki from UWE and Rajen Persad from North Bristol National Health Service Trust/ Bristol Urological Institute presented the SMARTsurg project at [RadioBristol](#) on April 1, 2017.

- **Meeting at the Istituto Italiano di Tecnologia (May 24 2017)**

On May 24th, 2017 Elena de Momi and Giancarlo Ferrigno went to IIT to discuss possible collaboration topics. In this frame the SMARTsurg project was presented to people of the Advanced Robotics Department (ADVR), Italian Institute of Technology (IIT), Italy.

- **25th Project Week**

The 25th Project Week was held on June 26-30, 2017 in Catanzaro Lido, Italy. It recorded 51 registered attendees, who worked on 26 projects. POLIMI presented SMARTsurg project at Project [Week 25/ Intra-operative deformable registration based on dense point cloud reconstruction](#) (June 30, 2017).

- [ICRA workshop](#) (June 2, 2017)

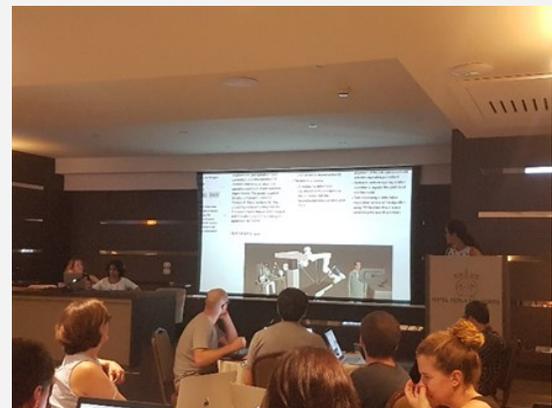
Presentation at ICRA 2017 workshop C4 Surgical Robots: Compliant, Continuum, Cognitive, and Collaborative

Elena De Momi from POLIMI presented: Collaborative interfaces for human robot interaction. Giancarlo Ferrigno participated in the discussion

- [Hamlyn symposium medical robotics](#) (June 26, 2017)

Elena De Momi presented the SMARTsurg project in the frame of the workshop: 'Context-Aware Control to Assist Surgical Targeting Gestures. Giancarlo Ferrigno was member of the PC of the meeting, attended the same workshop and participated to the final discussion.

- TheMIS team presented, on June 24, 2017, as guest speakers the SMARTsurg project in Hellenic **Orthopaedic Society's Advanced Knee Course in Athens**.



SMARTsurg meetings

- **SMARTsurg Project Kick Off Meeting**

The kick-off meeting was held in Bristol, United Kingdom on January 16-17, 2017 at the premises of the project coordinator, UWE.

During this event, the members of the consortium defined the purposes and objectives of the SMARTsurg project. Special attention was paid to the activities of the first year of the project reflecting the main preparatory objectives. Moreover, the agenda covered exploring project ideas and discussion of the three use-case studies (urology, cardiology and orthopaedic soft tissue surgery), requirements gathering and discussion regarding the ERF 2017 workshop organised by partners of SMARTsurg to showcase the project and its vision.



- **SMARTsurg 2nd Plenary Meeting**

The second plenary meeting of the SMARTsurg project was hosted by POLIMI in Milan, Italy on July 10-11, 2017. During the meeting, the partners had the opportunity to discuss on the implementation of the main principles of SMARTsurg and define the project action list and further steps for the forthcoming period. Special discussions were held on use cases and user requirements. During the meeting, partners also, had the chance to analyse the progress of the training on robotic arms.





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