Light ion therapy software for data exchange

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Control System Conceptual Model

Simplified diagram of CNAO’s control system’s layers
Applications and support services

Configuration and support environment

- Repository management applications
- Specialized monitoring applications
- Transmission of configuration settings to most control system components

Currently more than sixty software applications in CNAO
Project objectives

• Develop infrastructure for the development of the new generation of applications in the configuration and support environment.
• Addition of mobile devices to the control system.
• Allow technological upgrade.
• Ensure compatibility, and allow slow phase out of legacy environment applications.
• Address requirements for data access, security, and medical software certification.
• Development of pilot applications.
Design of a product line architecture for applications of the C&S environment:

- Product line architecture describes:
  - Each software layer.
  - The relationships between each layer.
  - Libraries and technologies used.
Design of Product line architecture

**Notation:** Adapted and simplified UML class diagram. Added color scheme. Stacked modules represent multiplicity.

- Object aggregation
- Instantiates
- Inheritance
Software libraries were designed to standardize the following communication in this environment.
Skeleton application generator

- Skeletons comply with the defined product line architecture.
- Out of the box with configuration of all standard services libraries.
- Customizable data manipulation forms for remote files, and database data.
- Currently two skeleton generators:
  - Repository management application generator.
  - Control system application generator.
Skeleton generator – examples

Project wizzard

Skeleton app
Skeleton generator – examples

Project wizzard

Skeleton app
### Skeleton generator – examples

#### Project wizzard

#### Skeleton app

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Pilot application - Timing system

- Two client application for the timing system:
  - Creation and loading of new acceleration cycles.
  - Monitoring of currently executed cycles.
- Currently under development.
Certification of medical software

Ideal Scenario

Real Scenario

Figure adapted from J. Rushby, and P.S. Miner, Modular certification, (2002)
Certification of medical software

- We have analyzed challenges of compositional development in the certification process.
- Highlighted several benefits that a composition-based development provides, based on the certification standards.
- Documented challenges that must be addressed.
- Compositional approach selected, which we expect to allow us to reduce the effort necessary for complying with the certification process.

Adapted from CEI EN 62304:2015-08 Fig1. Overlayed with authors remarks.
Impact of project

- Modernization of the software environment.
- Standard communication aids testability and maintainability, and may facilitate the medical software certification process.
- LabVIEW environment of control system 1st level is now being integrated to consume services developed.

```//TODO

/*
  - Develop the applications of the environment
  - Integrate OPC-UA authorization with OpenID Connect standard
  - Investigate the potential of opening web services to the outside world
*/```
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Monica Necchi
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