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Analysis of Requirements for the Design of a Detector Control System in a High Energy Physics Experiment

Precise knowledge of what a system requires is a principle that unquestionably marks the success or failure of a software development. Establishing and managing the requirements for the design of a system are fundamental aspects of software engineering. One of the main software systems in a High Energy Physics (HEP) experiment is the Detector Control System (DCS). The DCS allows the control, monitoring and configuration of the experimental equipment either from a single on-site place or remotely, through a Supervisory Control and Data Acquisition (SCADA) system. Likewise, DCS manages communications with various experiment' s services and systems, such as: the accelerator, cooling systems, electricity, magnets, safety, access control, among others; in addition to providing feedback to them.
On the other hand, the design, simulation, construction, installation, commissioning and operation of a detector in a HEP experiment are usually very complicated tasks. In addition to the large number of detectors and sub-detectors that need to be controlled independently by the corresponding DCS, there are also huge conceptual and structural differences among them, such as: types of events to be analyzed with particles collisions or cosmic rays, dimensions, materials (semiconductors, plastic scintillators, gas chambers), parameters to be monitored (temperature, radiation, magnetic field, position, cryogenic system, etc.), type of control actuators (cooling, high and low voltage channels, gas system, etc.), infrastructure, number of readout channels, etc. This complexity and diversity of detectors should always be considered when defining and specifying the requirements of the experiment's control system.
Based on the above an initial methodology that specifies and standardizes the requirements for the development, commissioning and operation of the software for a DCS should always be carried out when designing or upgrading a HEP experiment.
This work includes a brief description of the wide diversity of elements and aspects to be considered in the design of a detector control system. Subsequently, general definitions for the analysis of requirements in the design of a DCS are shown. Finally, the characteristics, functional and nonfunctional requirements and the use cases of main actors involved in the design, implementation and operation of these software systems are specified.

Primary author: CABANILLAS NORIS, Juan Carlos

Co-authors: MARTINEZ HERNANDEZ, Mario Ivan (Autonomous University of Puebla (MX)); ROJAS TORRES, Solangel (Universidad Autonoma de Sinaloa (MX)); LEON MONZON, Ildefonso (Universidad Autonoma de Sinaloa (MX))

Presenter: CABANILLAS NORIS, Juan Carlos

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