VDE - VIRTUAL DOCUMENTATION ENVIRONMENT

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Abstract

At LNLS hundreds of motors are used at the beamlines to move parts, equipment or full systems, according to different profile, synchronization and accuracy requirements. Historically, the documentation of motion axes of the LNLS beamlines was either done only at the moment of their installation and commissioning, or not properly done at all. Thus, after some time, keeping track of changes and performing maintenance could turn out to be very challenging, and there was the clear need of some solution to ensure that every change in motors would be reflected in their documentation. In 2012 the migration of the beamlines control system to the EPICS (Experimental Physics and Industrial Control System) [1] platform pushed the development of a new documentation system. In a first version, it consisted of a smart spreadsheet that generated the EPICS configuration files automatically. Later the spreadsheet evolved to a web-based system the VDE - Virtual Documentation Environment, which allows the beamlines staff to change the motion axis parameters without the need of a deep knowledge about EPICS and ensures the complete motion axis documentation intuitively. Also, changes in motors will not work in EPICS if the documentation is not updated, guaranteeing the link between documentation and the real system.

INTRODUCTION

Currently, around 700 motorized mechanisms are installed at LNLS beamlines, being used, for instance, to perform sophisticated optical alignment of mirrors and monochromators and position samples. These motorized mechanisms can be abstracted as motion axes, which are composed of motors (mostly stepper motors), gear boxes, transmission elements and encoders, when necessary. All these axes are integrated into the EPICS distributed control system of the beamlines and endstations.

The most common motion controllers at the LNLS beamlines are Galil [2], Parker [3] and IMS [4] devices whose EPICS IOCs (Input/Output Controller) run in a dedicated National Instruments PXI chassis [5], for the main beamline components, or in a Virtual Machine, in the case of separated endstations.

DPM

In 2012, with the need to document the motorized axes of the beamlines, until then based only on mechanical drawings, and to facilitate the software configurations, by providing all the relevant mechanical parameters, a standard configuration tool, the so called DPM, has been implemented. It was based on two spreadsheets, one being used as a library and the other, the master spreadsheet for the beamline. In the first, there were records of models and manufacturers, for motors, drivers and gearboxes, for instance, whereas the latter concentrated the information of each axis of the installation in a line on the spreadsheet. It also had the necessary information to perform all the needed calculations and determine the primary parameters of the axes as speed and resolution, for example. After all the axes were correctly registered in the master spreadsheet, the DPM was able to generate the necessary configuration files for the EPICS IOCs using VBA macros in the spreadsheet. Finally, all the configuration files were stored in text format and a LabVIEW application was used to transfer the file to the IOC server by FTP.

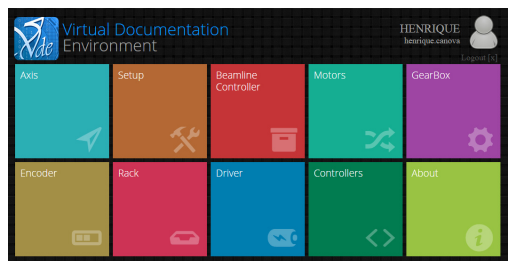

Figure 1: VDE home screen.

VDE

With the need to make a more robust tool, in order to avoid errors during the operation, and to add more features, the VDE was created. Allowing for greater versatility a web-based platform running on an Apache server, and a relational MySQL database is used. The main language of the system, to access the database and to manipulate the data, is PHP/JavaScript, whereas the pages designs are based on HTML5 and CSS3.

The VDE consists of a series of different web pages, each one giving access to each part of a motor axis and its respective entries. The home screen (Fig. 1) shows all the available options in the platform, with even though some of them are for the administrators only.

The system is integrated with the LNLS Active Directory System to provide a way for the user to login using the institutional username and password from any computer in the campus. Thereby, this enables the VDE to set different access levels to restrict access to certain sets of motors for the desired users. For example the home screen, viewing access to the registered common equipment is allowed for general user, however, only admins can edit or register new items. Naturally the administrators also have access to all axes in the database.

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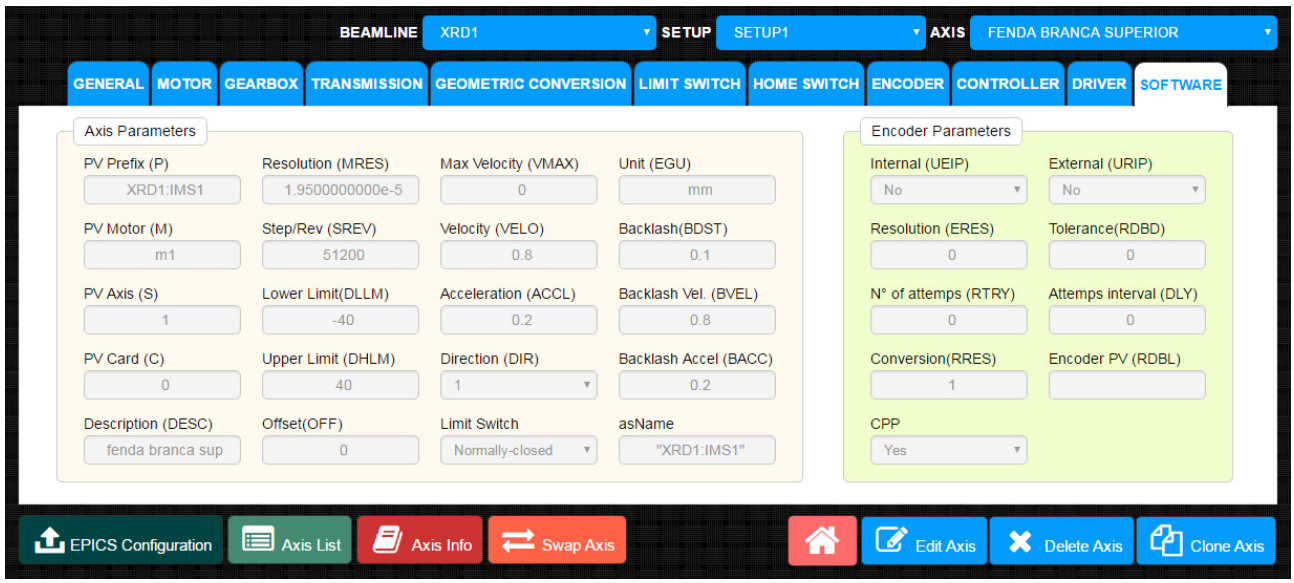

Figure 2: VDE axis configuration - Software options.

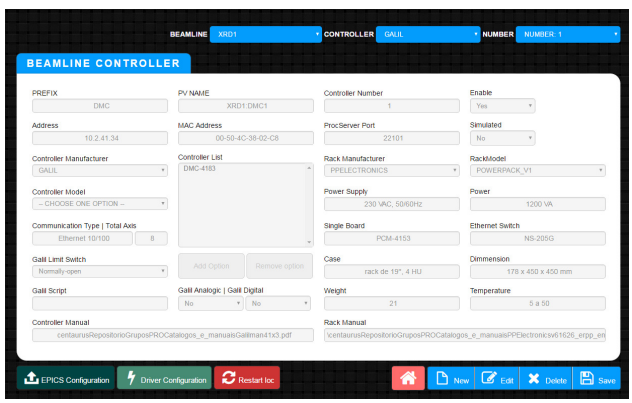

Figure 3: VDE controller screen.

Concepts

The VDE is based on the concept of Setups. Each installation (beamline or endstation) can have one or more Setups, each one consisting of a group of motor controllers (Fig. 3) and their respectively configured axes. This concept was created because the motor parameters often change at the beamlines depending on the experiment requirements, i.e., the same axis may have, for example, different speed and acceleration levels, or synchronism targets, for different experimental setups.

Previously, the beamlines staff needed to individually change the motors parameters for each experiment. Using the VDE, the setups may be pre-configured and stored, so that all the axes can be reconfigured at once.

Axis

After the registration of all existing motor controllers at the beamline or endstation, and the creation of the Setup structure, the axes are configured in a dedicated page (see Fig. 2). In this page, there are specific tabs for each component of the given axis, namely: general description of the axis, motor type, gearbox, transmission rate, geometric conversion, limit and home switch configuration, encoder, controller configuration, driver stage and software data (EPICS).

In the software tab, the records of the EPICS Motor Record [6] IOC are exhibited. Part of them can be modified by the users, whereas some are automatically calculated using data from other tabs. As an example, the step resolution (MRES) is determined using information from the motor, the gearbox, the transmission rate, and the geometric conversion tabs. For some cases, advanced options are available to modify IOC parameters and to create extra substitutions files.

Equipment

According to this work flow, the components must be registered in the VDE, building some kind of library. This work is shared by the beamlines electronics support group (GAE), which is responsible for the configuration of drivers and the physical connections, and by the beamlines software support group (SOL), responsible for the configuration and installation of the IOC in EPICS. Currently, motors, gear boxes, encoders, motion controllers, power stages (drivers) and racks (the controller chassis) from several manufacturers are already supported, but whenever new devices are to be installed, they must be properly registered in the system.

File Generation

After all the axes are properly configured, the generated configuration files, including the Motor Record substitution and command files of the IOC, can be sent to the EPICS host computer by SSH - Secure Shell - protocol under Linux. Figure 4 shows the auxiliary screen in which the user can select which controller family is to be configured. Currently, VDE can generate IOCs configuration files to Galil, Parker, and IMS controllers.

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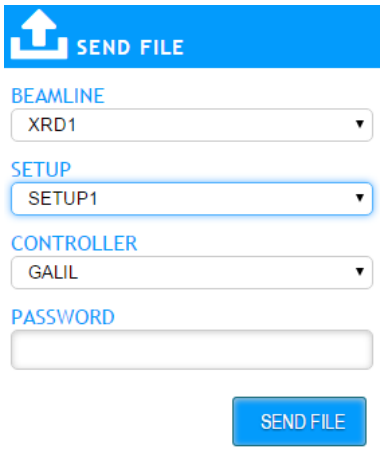
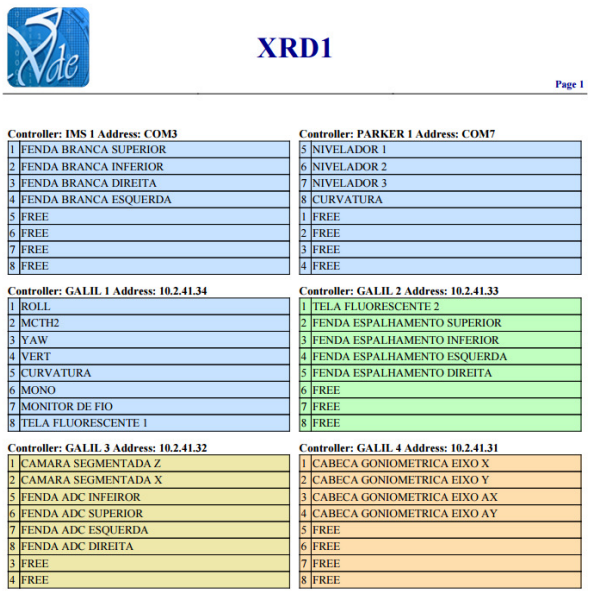


Figure 4: VDE - send configuration screen.

Reports

In addition to the online documentation, VDE is able to generate two types of report: one simply with the list of all registered axes in the Setup (see Fig. 5) and a detailed one with all the information gathered from each axis.



XRD1

Page 1

Controller: IMS 1 Address: COM3	
1	FENDA BRANCA SUPERIOR
2	FENDA BRANCA INFERIOR
3	FENDA BRANCA DIREITA
4	FENDA BRANCA ESQUERDA
5	FREE
6	FREE
7	FREE
8	FREE

Controller: PARKER 1 Address: COM7	
5	NIVELADOR 1
6	NIVELADOR 2
7	NIVELADOR 3
8	CURVATURA
1	FREE
2	FREE
3	FREE
4	FREE

Controller: GALIL 1 Address: 10.2.41.34	
1	ROLL
2	MCTH2
3	YAW
4	VERT
5	CURVATURA
6	MONO
7	MONITOR DE FIO
8	TELA FLUORESCENTE 1

Controller: GALIL 2 Address: 10.2.41.33	
1	TELA FLUORESCENTE 2
2	FENDA ESPALHAMENTO SUPERIOR
3	FENDA ESPALHAMENTO INFERIOR
4	FENDA ESPALHAMENTO ESQUERDA
5	FENDA ESPALHAMENTO DIREITA
6	FREE
7	FREE
8	FREE

Controller: GALIL 3 Address: 10.2.41.32	
1	CAMARA SEGMENTADA Z
2	CAMARA SEGMENTADA X
5	FENDA ADC INFEIROR
6	FENDA ADC SUPERIOR
7	FENDA ADC ESQUERDA
8	FENDA ADC DIREITA
3	FREE
4	FREE

Controller: GALIL 4 Address: 10.2.41.31	
1	CABECA GONIOMETRICA EIXO X
2	CABECA GONIOMETRICA EIXO Y
3	CABECA GONIOMETRICA EIXO AX
4	CABECA GONIOMETRICA EIXO AY
5	FREE
6	FREE
7	FREE
8	FREE

Figure 5: VDE - axis list report.

Administration

On the administration page (Fig. 6), it is possible to modify configurations, such as IP address of the EPICS host computers, and to add manufacturers do the database.

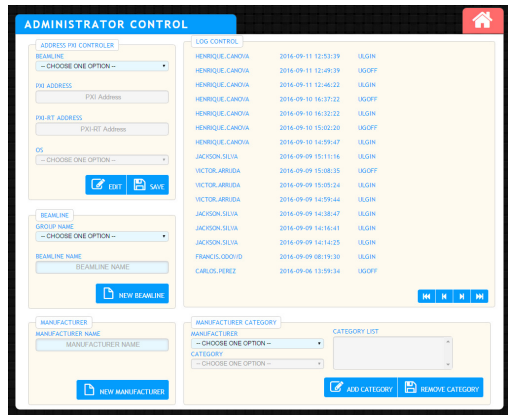


Figure 6: VDE administration page.

CONCLUSIONS AND PERSPECTIVES

The VDE is currently applied to all experimental stations and beamlines at LNLS and it is expected to be applied in the new accelerator, Sirius. The VDE development is ongoing and different manufactures as Newport [7] and Aerotech [8], are expected to be integrated to the file generation system soon. Another tool that is in the testing phase is the capacity to automatically change, not only the IOCs configuration but also lower level settings of the drivers, as current and resolution, for example.

ACKNOWLEDGEMENT

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