A MODEL-DRIVEN GENERATOR TO AUTOMATE THE CREATION OF HMIs FOR THE CERN GAS CONTROL SYSTEMS

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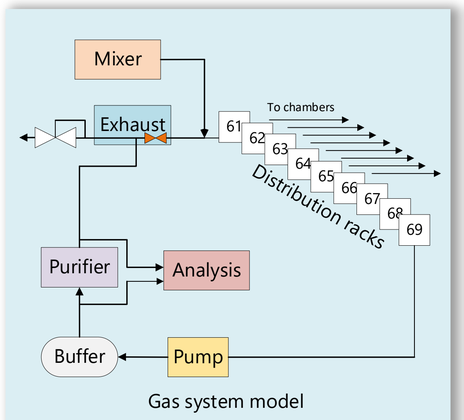
THPHA163

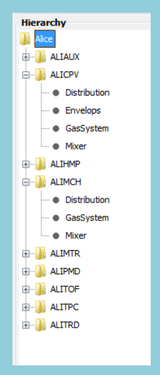


Gas system model

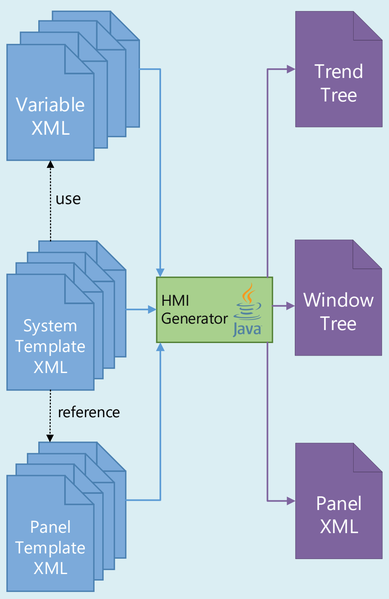
The gas control systems (GCS) of the LHC Experiments (ATLAS, ALICE, CMS, LHCb) consist of hundreds of operational user interfaces (UI), trends and navigation. The maintenance and evolution of all these UIs, e.g. if a new device is added to the plant, can be very heavy.

For those reasons, the decision was taken to automate the generation of these UIs.

A model driven approach is applied to produce the supervision layer of the plants where:
- A plant is always made of gas systems (i.e. sub-detector of an Experiment)
- A gas control system is hierarchically organized and made of gas modules
- The gas modules are standardised and homogeneous blocks, modelled by templates



The process



Inputs of the generator

Variables

All plants have a variable file

XML file format

Specifies all the installed gas modules

Each gas module is configured by one variable file
Currently more than 200 files for all deployed GCSs

Variable	Description	ATLAUX	ATLCSC	ATLMDT	ATLRPC	ATLTFC	ATLTGC	ATLTRT
subdetector	System Name	AUX	CSC	MDT	RPC	TFC	TGC	TRT
has_Mixer	standard module optional (option valid? 1=yes, 0=no)	0	1	1	1	0	1	1
has_Pump	standard module optional (option valid? 1=yes, 0=no)							
has_Distribution	standard module optional (option valid? 1=yes, 0=no)							

Variable	Description	ATLRPC	ATLTRT	ATLCSC	ATLTGC	ATLMDT
wago_node_nb	Number of wago nodes	1	1	1	1	1
double_mfc	is double MFC present? (1=Yes 0=No)	1	1	0	0	1
gas_lines	Number of Mixer gas lines	3	3	3	2	3
Liquid_line	Number of liquid line	0	0	0	2	3

Visualization of the variables. ATLAS experiment modules and Mixer module variables

System templates

Describes the plant with generation rules
Currently 33 system template files for all deployed GCSs

```
<panel>
  <template>SubdetectorOverviewTemplate.xml</template>
  <output>{panels_dir}/{prfx}_GasSystemOverview.xml</output>
  <variable type="integer" name="xPos">20</variable>
  <variable type="integer" name="yPos">40</variable>
  <rules>
    <set_property item="PanelHeader" prop="FileName">gcsSynopticHeader.pnl</set_property>
    <set_dollar ref="PanelHeader" name="$sTitle">"{subdetector} modules"</set_dollar>
    <rename_dollar_param param_name=".*" match="GCSPrefix" replace="{prfx}"/>
    <for variable="c_module" in="modules">
      <if variable="has_{c_module}" value="true">
        <if variable="c_module" value="Purifier">
          <for variable="c_pur" in="1:{Purifier_count}">
            <add_modul position="{xPos},{yPos}"
              panel="{prfx}\{prfx}_{c_mod}{c_pur}Summary.xml"/>
            <variable name="yPos">{yPos}+195</variable>
            <if expr="yPos > 810">
              <variable name="xPos">{xPos}+420</variable>
              <variable name="yPos">40</variable>
            </if>
          </for>
        </if>
        <if expr="c_module != Analysis and c_module != Purifier">
          <add_modul position="{xPos},{yPos}" panel="{prfx}\{prfx}_{c_module}Summary.xml"/>
          <variable name="yPos">{yPos}+195</variable>
          <if expr="yPos > 810">
            <variable name="xPos">{xPos}+420</variable>
            <variable name="yPos">40</variable>
          </if>
        </if>
      </if>
    </for>
  </rules>
</panel>
```

Example of a user interface generation rule

Panel templates

Pre-defined SCADA templates modified during the generation process

XML file format

Non static elements attached with control scripts

Currently 150 different panel template files for all deployed GCSs

Generation

Step 1: Processing the rules and variables that describe the plant
Step 2: Generation of the user interfaces
Step 3: Generation of navigation and trending files

Java

```
> java -jar gc.jar -t .\System.xml -i .\LHCb_variables.xml -o .\XMLGeneratorOutput/javaOutput
14:06:51.113 [main] INFO  ProcessMonitor - Generation was successful
14:06:51.114 [main] INFO  ProcessMonitor - Creating windowTree and trendTree
14:06:51.118 [main] INFO  Postprocessor - Writing LHCb`s window and trend trees...
14:06:51.118 [main] INFO  Postprocessor - Reading and processing navigation file: Inputs\LHCb.nav
14:06:51.125 [main] INFO  Postprocessor - Reading and processing WindowTree file: Inputs\LHCb.wt
14:06:51.192 [main] INFO  Postprocessor - Reading and processing trends file: Inputs\LHCb.tds
14:06:51.233 [main] INFO  Postprocessor - Reading and processing trendTree file: Inputs\LHCb.tt
14:06:52.373 [main] INFO  ProcessMonitor - Generation finished!
```

Output views and navigation

About the user interface generation

30 gas supervision systems are generated
User interfaces and window tree for navigation
Trends and trend tree for navigation

A medium-sized gas control system is composed of a total of ~500 files.

More than 400 input files available, including system templates with generation rules and variables

Benefits

A modification on a template or a variable file is a onetime process
Changes propagate to all user interfaces

The generation takes half a minute

Effort required for the maintenance and generation is much lower than following a manual approach

Same look & feel for the monitoring and control on the four LHC Experiments