An IRMIS Extension: cRIO Wiring Information System



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IRMIS 2 was developed by Argonne National Lab. Today it covers many aspects of EPICS control systems including IOCs, PVs, cables, models, etc.

- IRMIS 2 basically has
 - RDB modules and schema
 - PV crawler for loading PVs from database
 - GUI Application by Java
- Stable and used at APS
- But NOT supported by IRMIS community any more



LANSCE-RM Device Database System is a site IRMIS implementation to install, manipulate, track, and search the data and information for LANSCE control systems.

- IRMIS 2 Schema and tables
- IRMIS 2 PV Crawler
- Application based upon REST – Representational State Transfer
- More schema other than those covered by IRMIS
- More applications and features

ANSCE-RM Device Database System	
Home Mobile Login Channel Component LCS CCR Day Log Wire Scanner About	Heip
Mome Welcome to LANSCE-DM Device Database System! The LANSCE-RM Device Database is an AOT-IC project to build a relational latabase schema and corresponding GUI and web interface to install, manipulate, populate, track, and search the data and information bout LANSCE-RM devices.	Update and News DB Design For LANSCE-RM Presentation For RDB
Folks with iPad, iPhone or android devices, although you are still able to use the regular pages, might also be interested in here for nobile device friendly pages.	Comments to Kanglin Please stop by for update
 Since this system is developed on Firefox browsers, the other browsers, like Microsoft Internet Explorer, may or may not work correctly. So we strongly recommend you to use Firefox for this system. Note that this system also uses Javacript for front development ind some pages need cookies for verifying users. So please enable Javasript and cookie for your browser. Basically, they are default inabled. So you are prabably not needed to do anything. This system is under development. However, parts of system are available for testing. Currently, we have deployed: Please click here for PV fast search. Do you want to find the information for removed or expired PVs. Here you are. PV/Channel Report will dynamically generate a channel table and channel XLS spreadsheet with any field-column at your choice in it. Here is details. Switch or network devices table has been deployed. Go here if interested. Here is IOC information list. If you forget the launching point for an application in the treepml menu, please try this. Please try New Wire Scanner Information System by click it. Magnet power supply(MPS) list for the MPS team. Resolved MR fulltext search for software systems is at least helpful for me. CCR Dav Loop would keen the electronic conset of screenshots and loos if operators obtain or print daily loos via any of two applications located 	Associated Links CANSCE Software Team Work Controls Mesa Library Resolved SW MR Search Others Controls Doc Resources Network Status
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The LANSCE-RM Device Database System is developed by using many popular open source software, tools and frameworks.

- LAMP open source software packages
 - Refer to the first letters of <u>L</u>inux, <u>A</u>pache, <u>M</u>ySQL and <u>P</u>HP, <u>P</u>ERL or <u>P</u>ython
- Python Django framework for the server side
 - Pure python
 - MVC pattern
 - Free admin interface and user authentication ready
- SQLAIchemy SQL toolkit for database interface
- jQuery javascript library for the front-end client side and AJAX implementation
 - jQuery GUI framework for some special UI requirements
 - jQuery Mobile framework used for developing mobile-friendly pages
- Elasticsearch to provide powerful full-text search sever

The system has many more extensions and subsystems for the LANSCE control system other than a local and site IRMIS implementation.

- The PV system including the schema and crawler based upon IRMIS 2 posted on the EPICS web site as mentioned.
 - PV search and report generator
 - PV history including those changed and deleted
- LANSCE wire scanner information system
 - Wire scanner and actuator general info like locations, chassis, IP, etc.
 - Configuration and initial parameters
- LANSCE daily log and archive management system
 - Auto archiving to save operators' work and time
 - Full-text search for historic data
- LANSCE switch and network device system
- Legacy RICE channels system for timed/flavored data

Screenshots of implementation of IRMIS at LANSCE: PV Search Page - Similar to the APS IRMIS 2 Java Application

LANSCE-RM Device Database System	Hele
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Select All Select All Clear All Clear All History Mode	
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Screenshots of implementation of IRMIS at LANSCE: PV search result based upon the previous slide – similar to the APS 2 Java application Ajax call to avoid to change the URL and

db.lcs.lanl.gov/pvfind/			
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185,002197	bi		
LBB D02L98	bi		
LBBN 001101	ai		
LBBN 001102	ai	¥	
LBBM 01103	ai	Ŧ	
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Used by Field	Type With Field Value		
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Lnannel Search Resu		
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LBBL001L03	bi	•
LBBL001L97	bi	
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BBM001102	ai	
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DISV	1	U
DTYP	EtherIP	
EVNT	0	
FLNK	0.0000 0000000000e+00	
NP	@lxplc1 Digital_Readback_3 B 1	15
DNAM	OUT	<u>+</u>
IOC Name: eb1 DB File: /solaris/epics/lcs/eb1/	data/eb1.db	
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nannel Links		

Screenshots of implementation of IRMIS at LANSCE: PV REPORT TEMPLATE – Dynamically Generate a PV Report with FIELDS at Users' Choice



Screenshots of implementation of IRMIS at LANSCE: PV report generated dynamically

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O 01JC001L05	bi	sja	PA P/W C/B		01JC001L06.VAL	0	C	hannel Info	
O 01JC001L06	bi	sja	PA AMP C/B		01JC001L07.VAL	0	Ca	able # and Terminal Mapping	
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O 01JF001L02	bi	m01iioB	7835 VSWR		0.000000000000000e+00	0			
O 01JF001L03	bi	m01iioB	IPA IP FLT CHECK		0.000000000000000e+00	0	Fi	eld Value	
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O 01JF001L08	RICE	lcs	RF PERM FP						
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Screenshots of implementation of IRMIS at LANSCE: PV report generated dynamically - Continued

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01/001/03 bi EVNT 0	0	Component
FLNK 01JC001L06.VAL	0	Channel Search
01jC001L04 DI INP #80 C1 N7 @2	0	Channel Info
OIJC001L05 DI ONAM OK OIJC001L06.VAL	0	Cable # and Terminal Manual
01JC00106 bi OSV NO_ALARM 01JC001L07.VAL	0	Cable # and Terminal Mapping
01JC001L7 bi PHAS 0 0.000000000000000000000000000000000	0	
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01JF001L02 bi PRIO LOW 0.00000000000000000000000000000000000	0	
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The LANSCE cRIO wiring information system is designed as a subsystem and extension of LANSCE IRMIS device database system.

- To share wiring terminal codes between our hardware team, software team, operators and other users.
- To centralize the wiring information rather than each one has his own spreadsheet.
- To make the wiring information update easy.
- To save our engineers' time and effort for troubleshooting and maintaining our control system.
- To associate and map with LANSCE IRMIS Device Database System and find information like
 - PV and record field values
 - IOC and its location
 - DB, DBD file locations, etc.

The cRIO, a product of National Instruments (NI), combines a real-time controller chassis, reconfigurable IO modules, and FPGA module.

cRIO Hardware and software

- Power PC, Intel Atom processor, and Intel Core i7 processor
- DDR memory and nonvolatile storage.
- Ethernet ports and RS232 serial ports
- VxWorks for free with hardware or NI Linux Real-time with embedded UI and Mini Displayport
- LabVIEW, a NI graphical programming language, for programming the hardware and particularly for coding FPGA
- EPICS integrated via NI CA
- Embedded EPICS
 - A Special Board Support Package (BSP) required
 - Additional configuration required

The cRIO wiring information system is developed and built on MongoDB, a NonSQL document-oriented system and other other open source toolkits.

- MongoDB 3.2.8 for data model rather than SQL schema because of
 - Fast development
 - Simple data model
 - Flexibility and no complex joins
 - Scalable architecture but the feature not really used in our site
 - A first step to upgrade our IRMIS system to a NonSQL system
- Pymongo-3.3.0
 - A Python distribution containing tools for working with MongoDB
- mongo-c-driver, mongo-cxx-driver and swig
 - To build C/C++ library to talk to MongoDB and an interface wrapper for our existed TCL applications
- Other toolkits and frameworks mentioned above for IRMIS on our site

Although this wiring information system is pretty simple, it does store important information for our daily work.

- IOC name
- cRIO Module name
- Module slot
- Terminal code
- PV name
- cRIO module channel
- Wire label
- Wire color
- IO item label

```
File Edit View Search Terminal Help
> Use Wireinfo
switched to db Wireinfo
> db.stats()
{
        "db" : "Wireinfo",
        "collections" : 1,
        "objects" : 4754,
        "avgObjSize" : 222.11022297013042,
        "dataSize" : 1055912,
        "storageSize" : 356352,
        "numExtents" : 0,
        "indexes" : 1,
        "indexSize" : 86016,
        "ok" : 1
}
```

We associate this system with our IRMIS device database system to query the PVs' field values needed for control development and troubleshooting.

- To do so, we first join IRMIS tables including Record Names, Record Types, IOC names, Field Names, Field Values, etc.
- And then query and filter by PV name

Screenshot of the LANSCE wiring information system and applications

Clicking the radio button of PV 21TM001L01and then clicking "Channel Info" button, we can get its field values.

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	m	21iio	5	ni9477	T01: B5: J1: 8 J1:16		DO7						ONA	M YES				
	m	21iio	5	ni9477	T01: B5: J2: 1 J2:9		DO8						OSV	MAJOR				
С	m	21iio	5	ni9477	T01: B5: J2: 2 J2:10		DO9						OUT	#C5 S4 @Latch Back 10 ms	#C1 S4			
С	m	21iio	5	ni9477	T01: B5: J2: 3 J2:11		DO10						PHAS	0				
C	m	21iio	5	ni9477	T01: B5: J2: 4 J2:12		DO11		· · · · ·				PINI	NO				
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Future Works

- New PV database implementations based on NoSQL at LANSCE
 - New crawler for NoSQL PV database
 - · Applications based upon the backend
- IOC information system based on NoSQL
 - New crawler for IOC information system
 - Related applications
- Add more data like locations and rack numbers into the wiring information system