Nuclear Instruments and Methods in Physics Research A 633 (2011) S45–S47

Contents lists available at ScienceDirect

Nuclear Instruments and Methods in Physics Research A

journal homepage: www.elsevier.com/locate/nima

Remote control of ATLAS-MPX Network and Data Visualization

D. Turecek *, T. Holy, S. Pospisil, Z. Vykydal

Institute of Experimental and Applied Physics, Czech Technical University in Prague, Horská 3a/22, 12800 Praha 2, Czech Republic

ARTICLE INFO

Available online 26 June 2010

Keywords:
Pixel detectors
Medipix
ATLAS
Remote control system
Data visualization

ABSTRACT

The ATLAS-MPX Network is a network of 15 Medipix2-based detector devices, installed in various positions in the ATLAS detector at CERN, Geneva. The aim of the network is to perform a real-time measurement of the spectral characteristics and the composition of radiation inside the ATLAS detector during its operation. The remote control system of ATLAS-MPX controls and configures all the devices from one place, via a web interface, accessible from different operating systems. The Data Visualization application, also with a web interface, has been developed in order to present measured data to the scientific community. It allows to browse through recorded frames from all devices and to search for specific frames by date and time. Charts containing the number of different types of tracks in each frame as a function of time may be rendered from the database.

1. Introduction

A network of 15 ATLAS-MPX detectors has been installed inside the ATLAS detector and in the surrounding cavern in the framework of the ATLAS-MPX collaboration [1]. These detectors are capable of providing quantitative real-time information on the fluxes and flux distributions of the main radiation types in the experiment, including slow and fast neutrons produced during the LHC operation. The remote control system of ATLAS-MPX has been created in order to control and configure all devices from one central place. All the data measured during the experiments are presented for the scientific community by the Data Visualization Application.

2. The ATLAS-MPX device

The ATLAS-MPX devices are based on the Medipix2 single photon counting chip [2]. Each detector is assembled with a 300-μm-thick silicon pixel sensor (matrix of 256×256 square pixels with 55 μm pitch) which is covered by a mask of neutron converting materials—^{6}LiF and polyethylene (PE).

These conversion materials and their overlaps with the aluminum support foil divide the sensitive area of each device into six different regions (see Fig. 1b). The region mask is generated individually for each device.

3. ATLAS-MPX Network

The ATLAS-MPX Network consists of 15 ATLAS-MPX devices and 4 computers. The devices are connected to the computers by USB interfaces [3] with radiation hard LVDS extenders [4]. Three of the 4 computers are running Microsoft Windows operating system and Pixelman software package [5]. Each of these 3 computers is controlling 5 ATLAS-MPX devices. The last computer is running the Linux operating system and hosts the Remote Control and Data Visualization Applications. This computer controls the whole network, stores measured data and presents results of measurements through two web-based interfaces.

4. Software architecture

Every 5 ATLAS-MPX devices are controlled by one Pixelman software package. The functionality of Pixelman software can be extended by means of plug-in modules. In order to control Pixelman over the network, a Remote Control plug-in was developed that extends Pixelman with a TCP/IP network interface. This network interface is used by the Remote Control Application to configure and manage the devices see Fig. 2. For security reasons, the Remote Control Application is only accessible within the ATLAS network.

All the measured data are analyzed on-line by a Cluster Analysis plug-in for Pixelman and all raw data as well as the results of the cluster analysis are saved in each Windows computer and a copy of data is transferred to central Linux computer. Here, the results of cluster analysis and the parameters of each frame are saved into a MySQL database. This database is

* Corresponding author. Tel.: +420 22435 9396; fax: +420 22435 9392.
E-mail address: daniel.turecek@utef.cvut.cz (D. Turecek).

0168-9002/$ - see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.nima.2010.06.117

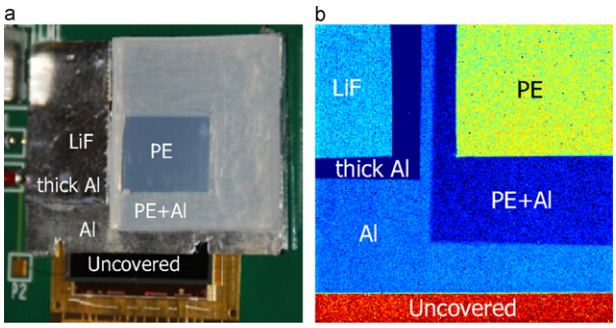

Fig. 1. (a) Photography of a Medipix2 detector with mask of neutron converting materials on the top. (b) X-ray image of the six different detection regions. The pictures are not the same scale.

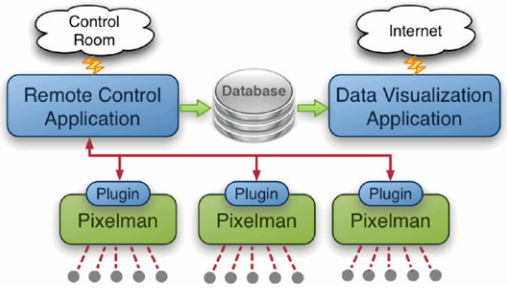

Fig. 2. Schema representing the Remote Control and the Data Visualization Software architecture.

used later by the Data Visualization Application that can be accessed worldwide via the Internet.

5. Remote Control Application

The Remote Control Application is intended to manage all devices from one central place. It provides users with a web interface, accessible from different operating systems. The detectors may be configured one by one, or a common configuration can be applied to all detectors in one step.

Users may create groups of detectors that can be configured simultaneously according to the needs of an experiment. The configuration of detectors can be saved into profiles and loaded again later.

Progress of measurement of each detector may also be observed. The system distinguishes different access levels and for each user different access rights may be specified.

6. Data Visualization Application

The Data Visualization Application features a web interface as well. It is intended for scientific community as well as for a worldwide public. It allows users to browse through the history of all measured frames from all detectors and to search for specific frame by date and time, see Fig. 3.

The measured data frames are analyzed by the Cluster Analysis plug-in for Pixelman software. This analysis recognizes characteristic traces corresponding to different types of ionizing radiations in each detector mask region.

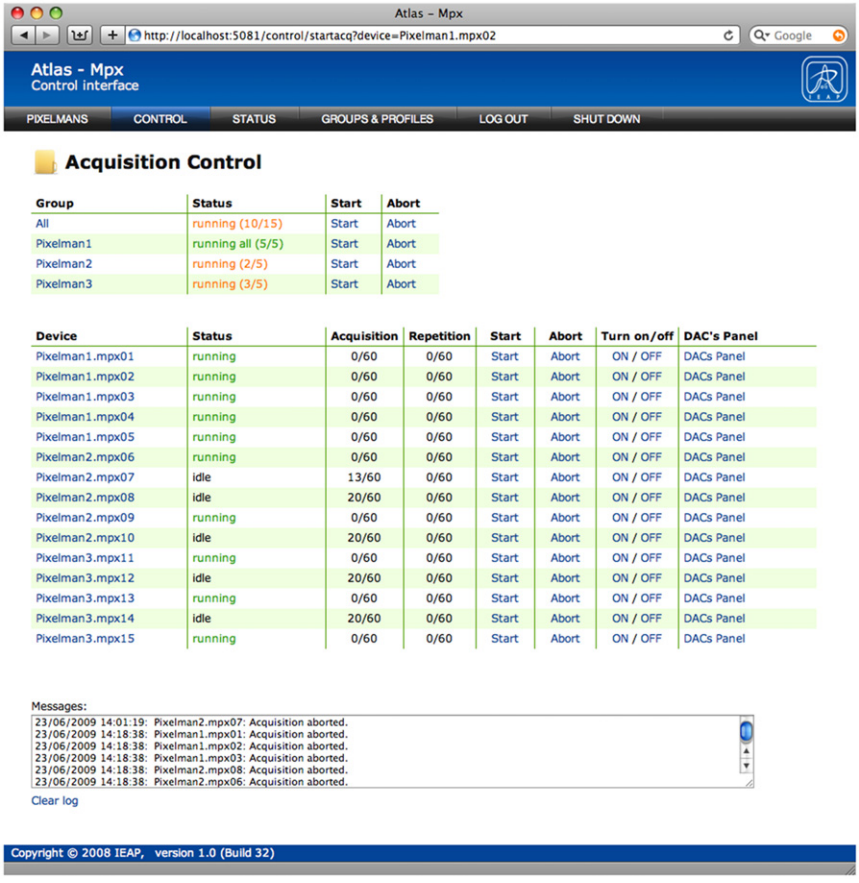

Fig. 3. Screenshot of the Remote Control Application: detectors status and control possibilities.

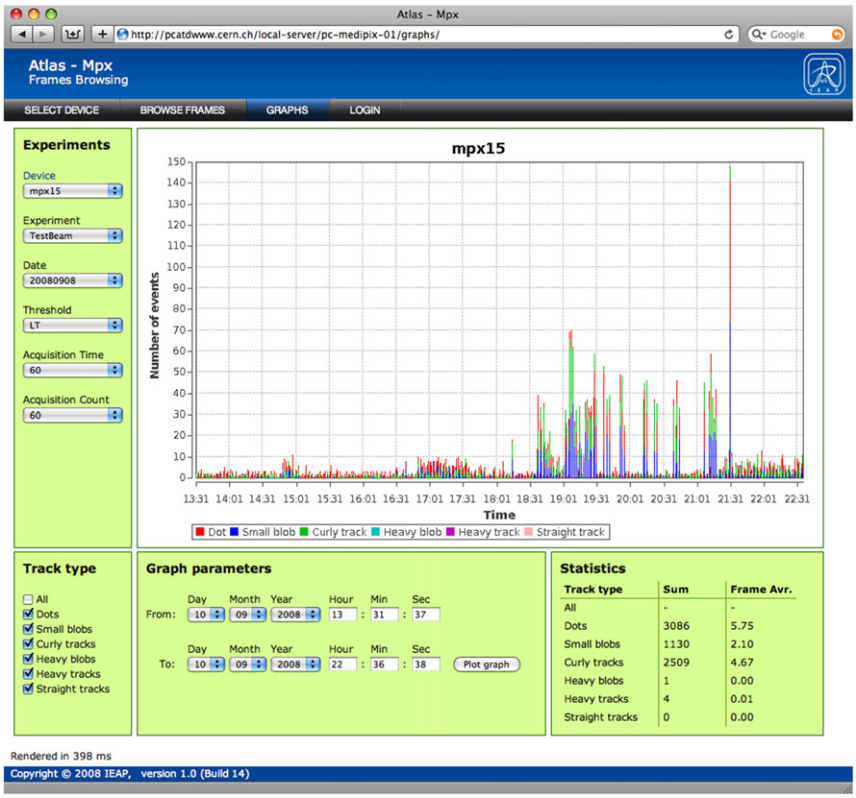

Fig. 4. Screenshot of the Data Visualization Application: chart with number of characteristic traces in frames in specified time range.

Charts containing the number of different characteristic traces in each frame as a function of time may be extracted from the database, see Fig. 4. It is also possible to render the number of traces in specified region or number of traces of one trace type in different regions.

7. Conclusions

A network of 15 ATLAS-MPX devices has been installed in the ATLAS cavern in CERN. The Remote Control Application as well as the Data Visualization Application is fully functional. All devices can be managed through a web interface from one place. Data measured by our detectors are available worldwide through the Data Visualization Application (see Ref. [6]).

Acknowledgements

This work was carried out within the CERN ATLAS-MPX Collaboration and has been supported by the Ministry of Education, Youth and Sports of the Czech Republic under Projects 6840770040, 6840770029, LC06041, LA08032 and NSERC, Canada.

References

[1] M. Campbell, C. Leroy, S. Pospisil, M. Suk, Measurement of spectral characteristics and composition of radiation in ATLAS by MEDIPIX2 USB devices, Project proposal at ⟨https://edms.cern.ch/document/815615⟩.
[2] X. Llopart, M. Campbell, R. Dinapoli, D. San Segundo, E. Pernigotti, IEEE Trans. Nucl. Sci. NS-49 (2002) 2279.
[3] Z. Vykydal, J. Jakubek, S. Pospisil, Nucl. Instr. and Meth. A 563 (2006) 112.
[4] Z. Vykydal, J. Bouchami, M. Campbell, Z. Doležal, M. Fiederle, D. Greiffenberg, A. Gutierrez, E. Heijne, T. Holý, J. Idarraga, J. Jakůbek, V. Král, M. Králík, C. Lebel, C. Leroy, X. Llopart, D. Maneuski, M. Nessi, V. O'Shea, M. Platkevič, S. Pospíšil, M. Suk, L. Tlustos, P. Vichoudis, J. Visschers, I. Wilhelm, J. Žemlička, Nucl. Instr. and Meth. A 607 (2009) 35.
[5] T. Holy, J. Jakubek, S. Pospisil, J. Uher, D. Vavrik, Z. Vykydal, Nucl. Instr. and Meth. A 563 (2006) 254.
[6] Operation page of the ATLAS-MPX network measurements at ⟨https://atlasop.cern.ch/local-server/pc-medipix-01/⟩.