HDMC: An object-oriented approach to hardware diagnostics

Abstract:

A software package has been developed, which provides direct access to hardware components for testing, diagnostics or monitoring purposes. It provides a library of C++ classes for hardware access and a corresponding graphical user interface. Special care has been taken to make this package convenient to use, flexible and extensible. The software has been successfully used in development of components for the pre-processor system of the ATLAS level-1 calorimeter trigger, but it could be useful for any system requiring direct diagnostic access to VME based hardware.

Summary:

Developing electronics involves a fair amount of testing, where direct access to hardware via a computer is required. In addition to low-level test tools like oscilloscopes or logic analysers higher level diagnostic facilties are essential for more complex tests. This includes software to access the developed hardware in an extensive and easy-to-use way to perform diagnostics and monitoring of individual or complete groups of components. Similar functionality is required for later integration in extended hardware and software frameworks.

The presented software package, called HDMC (Hardware Diagnostics, Monitoring and Control), addresses these needs. It provides a library of components for accessing hardware objects like registers, memories or FPGAs on VME modules or within devices not directly accessible to VME, but located on a VME module. It's also possible to access a VME bus via a network connection in a client/server configuration. A graphical user interface based on this library provides hardware access without requiring special knowledge about software development. The library can also be used for more direct access based on compiled or scripting programming languages for testing or integration into other software environments.

HDMC is implemented as a set of C++ classes, representing hardware components in a common framework. This is used to provide common ways to access similar components, to transmit data between components and to handle them in a uniform way. A simple and clean interface for direct hardware access is provided as well as a more abstract one for access through a graphical user interface. Register descriptions are loaded from human-readable configuration files in such a way that a lot of hardware development can be made without the necessity to recompile the software.

The graphical user interface allows construction, manipulation and access to VME modules and other components in a convenient and uniform way. Access to hardware configurations can be built using the interface and changed at run-time. There is also a plot and histogram component and facilities to present special views of hardware configurations like modules and crates.

HDMC supports a variety of UNIX platforms like Linux, Solaris and HP-UX, For VME access several VME single-board computer are supported, running Linux or LynxOS. Platform support could be extended to Windows without major rewrite and addition of other bus systems like CompactPCI is possible without change in the remaining framework or components.

For development of HDMC an open-source process is used. Source code and documentation is publicly available in the internet and it is open for contributions of any interested party.

The software package has proven to be a useful and reliable tool for diagnosing hardware. It has been used for the pre-processor system of the ATLAS level-1 calorimeter system, whose current development activities are based on a flexible VME test system, but other systems in need for a software tool for hardware diagnostic could also benefit from the HDMC software.