Feature Article

50th Anniversary Product

Laboratory Automation System stars (HERT-7000)

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Recently, a greater variety of measurement instruments and computer systems is increasingly demanded to shorten development time of a new car. In response to this, HORIBA, after forming an alliance with RICARDO (United Kingdom) and Schenck (Germany), have developed the new stars (HERT-7000) Laboratory Automation System. A Laboratory Automation System (LA system) is an automated measurement and control computer system. Each company's strengths have combined in this system, which has the latest Road Load Simulation (RLS) function and greater flexibility than previous products.

Introduction

The circumstances surrounding automobile development are under heavy pressure either from the requirement to reduce environmental impact or the opposite - to pursue higher performance.

In this situation, further acceleration of product development to survive against fierce competition is necessary and requirements for various measurement instruments and computer systems to support this accelerated development are also getting higher.

HORIBA, combining expertise acquired through previous products, its strengths in the field of exhaust gas analyzer, and the strengths of each of the partner companies has succeeded in developing a system which is flexible for the user without having to modify software.

Outline of stars Software for HERT-7000

Figure 1 shows the system block diagram. Stars is the software platform developed by SRH, and HERT-7000 is HORIBA's LA system which uses stars software for engine test cell.

The software has been developed by SRH (United Kingdom), which has been established through the alliance with Schenck and RICARDO. The supported languages are English, German, and Japanese, but otherwise the code is identical. For example, Japanese is used in Japan but by switching to English the same system can be used either in Japan or in other countries.

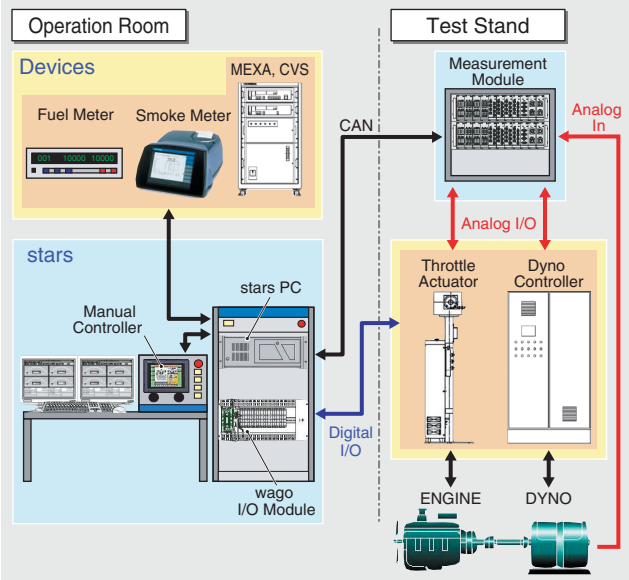

Figure 1 System Diagram

Features of the HERT-7000

This product's most important new features are the powerfully versatile configuration functions and the latest Road Load Simulation.

The previous system often required modification of the software to add a new test to the system. The requirement to modify software has been one of the factors that have slowed development, as it generally means that the test cell must be stopped for a long time.

However, the HERT-7000's powerful configuration functions enable the creation of various complex tests without modification of the software and therefore enable a quick response to user requirements.

Furthermore, users can create entirely new tests by themselves through these functions. It means that users can implement a new test at any time without the delay caused by modification of the software.

The latest RLS, which is RICARDO's technology, has been prepared as an option. This can shorten development time testing by simulating the real vehicle using only the engine, i.e. no chassis is needed.

The main functions of the software are as follows.

Work Flow and Script

The Work Flow (WF) and scripting are the main functions to realize the user requirements flexibly. These functions help users and/or engineers to customize various settings and operations without changing the software.

Work Flow

WF is the visual flow that defines the sequence of the test procedure. WF is a kind of special macro to be used for implementation and automation of the test procedure and can be easily created by users using an exclusive editor.

A general test procedure is composed of various processes, such as window display, condition setting, pre and post-operation in the measurement instrument being used, execution of the test cycle, data analysis and reports creation. With a variety of processes at their disposal, users can combine them and create their own WF.

Each process is prepared as an icon called a WF Block and setting-up this WF Block means defining the details of processes to be executed.

WF Block can be classified roughly into three groups: A group to provide an interface for users, a group to execute the activities, and a group to control the flow. Combining each WF Block makes a complete WF.

A basic WF is formulated by simple combinations of WF Blocks to execute the operations sequentially and automatically. While the WF is running, the processes defined in each WF Block are performed sequentially.

Figure 2 shows an example of basic WF.

To give an actual example, a WF can realize the test procedure containing not only engine/dynamo operation but also the control of the device such as an emission analyzer, typically represented in a test defined by various emission regulations.

In other words, this function allows the user to create a customized test according to entirely new emission regulations.

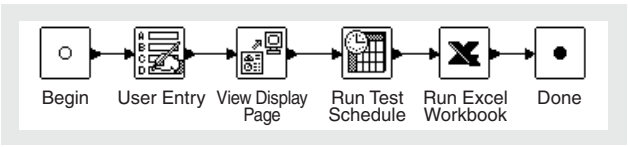

Figure 2 Example of Work Flow

Script

Script is a macro created using stars' own descriptive language. This can be edited in the test schedule editor.
This function provides the HERT-7000 with further flexibility and realizes the operations such as fine conditional branching control and the execution of complex calculations which the WF alone cannot realize.
The grammar of the script language is easy to understand, like that of Microsoft™ Visual Basic and script creation is rather easy for the user who has a little knowledge of that language.
The Figure 3 shows the Script Editor.
The script can execute the measurements, device control, calculations and so on using the methods (Arithmetic functions, commands and so on are provided by the device driver) and variables (the measured data, the configuration data and so on) supported by HERT-7000 in the script editor.

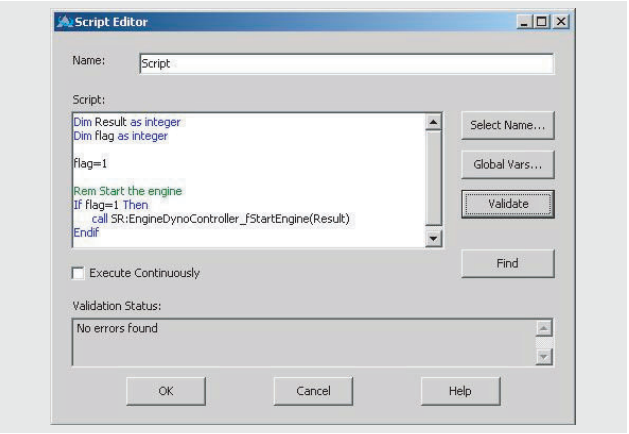

Figure 3 Script Editor

There are two script types. One is executed once and the other is executed repeatedly after starting. Using a script that executes repeatedly enables to create a routine that goes to a subsequent process after waiting until some condition is satisfied much easier.
This function is fully accessible to users and can be implemented as required.

Driver for HERT-7000

The device driver for HERT-7000 is a software component that enables the HERT-7000 to use various peripheral devices. Units that need real-time performance, one of the vulnerabilities of Windows™, are equipped with Ardence (formerly VenturCom) RTX, Real-Time extension for Windows™, to cover real-time performance.
The HERT-7000 supports many device drivers including an engine dynamo controller and a general purpose I/O measurement instrument which are included as standard. In addition, engine emission measurement instruments, constant volume samplers, fuel flow meters, smoke meters and so on are optional. Currently the HERT-7000 supports HORIBA MEXA-7000 and MEXA-9000 series for the engine emission measurement instrument, and CVS7000 and CVS-9000 series for the constant volume sampler.
The Figure 4 shows the driver configuration.
The traditional system does not allow easy installation of the device driver to be used but the HERT-7000 enables users to do so easily. Users can use the device by adding its device driver from the Hardware Inventory (the available device list) to the Test Stand (test equipment information).

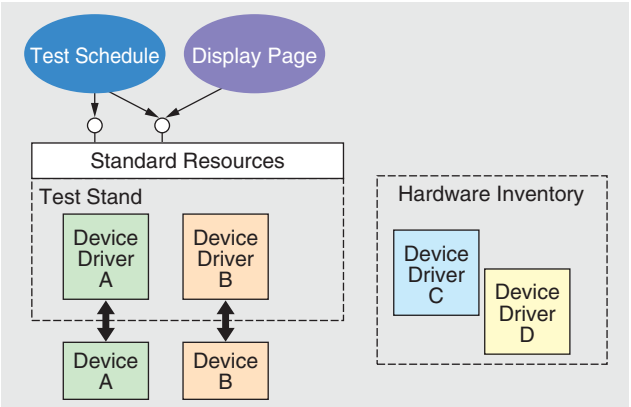

Figure 4 Driver Configuration

The device driver has an interface of methods for device control and variables for device status display and measurement value display. Each type of device has an interface definition called a Standard Resource, through which the HERT-7000 accesses the device driver. For this reason, applications such as the test schedule in the HERT-7000 can be reused even after the model is changed, for instance, from MEXA-9000 series to MEXA-7000 series.
Users can also access the device driver from the Display Page, which is a virtual control panel. On the Display Page, users can freely arrange the digital meter display and device-control buttons as well as create and edit the test screen. It is also possible to operate each device from a HERT-7000 by assigning various devices on the HERT-7000 to the arranged buttons.
The HERT-7000 also has optional low-level drivers equipped with protocols such as TCP or RS-232. Users can create a flexible interface with devices that the HERT-7000 does not support via its standard specification by using the above drivers and the aforementioned script.

Road Load Simulation

In traditional engine test cell, engine performance and characteristics are mainly measured at steady state. And this differs from its behavior on a real vehicle especially in transient operation.

On the other hand, shorter development time (which realiases faster response to the market and minimizes cost) and integrated control with the vehicle to improve performance and environmental conformity becomes more and more important in contemporary engine development.

A solution to these requirements is the RLS test which simulates vehicles on the road at the engine test cell.

The association with RICARDO, an alliance member of SRH, reduced our time and cost to develop unique RLS capability on HERT-7000 by merging their VCOT (Vehicle Calibration On Testbed)[1][2], the time-proven RLS tool used actually for on-board development of engine transient performance in RICARDO.

This VCOT technology has been validated with correlation of:

- Emission with vehicle on chassis rolls and engine on Testbed (Figure 5).
- Engine/aftertreatment thermal response in vehicle and on Testbed.
- Drivability maneuvers performed in vehicle and simulated on Testbed (Figure 6).

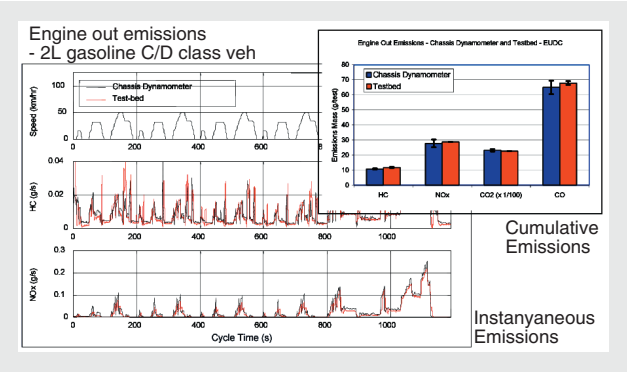

Figure 5 Emission Correlation Test Result of VCOT

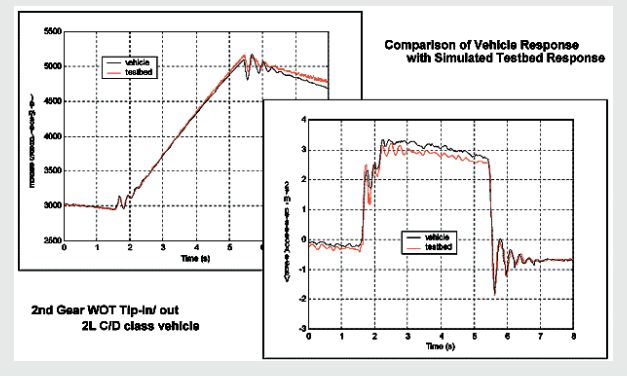

Figure 6 Drivability Correlation Test Result of VCOT

In addition, integration to the HERT-7000 brings the following benefits:

- Completely seamless handling of the real-world signals and virtual signals form simulation model in control, measurement and display; All signals are handled on same real-time OS.
- User can parameterize/setup RLS model with minimum parameter settings to meet ones purposes; Any parameter is classified into two levels on the editor, basic parameters and advanced parameters,.
- Users can easily create/modify their own RLS test using test schedule and WF, including integrated control of the measurement devices of whole HERT-7000 system.
- In Addition, user can choose optional capability to convert their own vehicles and driver models written in Simulink® to the code module that can be executed on the HERT-7000.

The Figure 7 shows a screenshot example executing RLS test.

Figure 7 Screenshot Example Executing RLS Test

Conclusion

This product is an advanced and higher value added system, which is more engine-development oriented than previous products. In spite of the many challenges encountered during development with our partners abroad - such as communication, time difference, and culture gaps, the alliance has worked very well.

We would like to contribute to our customers' efforts to globalize the automotive industry through this product, our technology and our own global network.

Reference

[1] R. E. Dorey, J. D. McLaggan, J. M. S. Harris, D. P. Clarke and B. A. C. Gondre, Transient Calibration on the Testbed for Emissions and Driveability, *SAE Technical Paper* 2001-01-0215 (2001).

[2] R. E. Dorey, R. H. Thring, D. P. Clarke, P. J. Hopwood, A. J. Marshall and J. D. McLaggan, Vehicle Calibration on the Testbed (VCOT), *SAE Technical Paper* 2000-01-1144 (2000).