

USING PLANT SPECIFIC MMI IN CBT

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Introduction

With the advent of PC-based training simulators came the daunting task of emulating the Man Machine Interface (MMI) on a PC platform. It soon became apparent that the subsequently developed MMI screens could be used for more than just a replica of the plant human machine interface. This paper discusses alternative uses for the emulated MMI screens, but is focused on using emulated MMI screens as a front-end to a Computer Based Training (CBT) application.

Background

Several DCS hardware vendors use expensive proprietary hardware that can significantly increase the cost of a MMI simulated simulator. In an attempt to lower the cost of simulation, the simulation vendors turned to MMI emulation. However, the development of an accurate MMI representation for use with a training simulator was a complex task that left margin for human error. As a result, different simulator vendors developed different approaches.

Some of the first techniques developed to emulate the DCS MMI on a PC platform were rather crude, time-consuming, and costly. However, as the software development tools on the PC platform became more sophisticated, the task of emulating the MMI became more efficient. Today, the use of translator technology is a common technique used to provide cost-effective emulation of a DCS MMI.

In its broadest sense, translation of the DCS MMI screens implies using software that converts the DCS MMI

configuration files into a format that can be used directly on the PC. Some MMI translators perform a partial translation in that they convert the DCS graphical information into a more usable form, after which the screen logic is manually encoded. The more useful translators, however, perform complete translations as they replicate the MMI on a PC with no human intervention.

As stated above, the only requirement for a translator is to convert the DCS MMI configuration information into a format that can be used by a PC. There are a number of graphic packages available for the PC that can be used in conjunction with the translator, or the MMI translator can use a vendor specific or proprietary approach. The most flexible translators convert the DCS MMI configuration information into a standard programming language. One such standard programming language is the Microsoft Visual Basic Language. Visual Basic is a powerful easy to learn language used for developing windows based applications. When the translators convert the MMI configuration files into Visual Basic projects, anybody familiar with the Visual Basic language can manipulate the MMI project files to enhance, or create new uses for the MMI screens.

The MMI translators developed by Framatome Technologies convert the DCS MMI configuration information into Visual Basic projects that are subsequently compiled using the Visual Basic compiler. All resulting MMI screens are stand-alone Windows based applications that can be executed on any Windows PC (Windows 95, 98, or NT). In a simulation environment, each MMI screen communicates the operator's actions to, and obtains data from a simulation of the physical process. The next section discusses other potential uses for the MMI screens that, for the most part, do not require use of a full-scale training simulator.

Other Uses for Translation Technology

Because the Framatome Technologies' translators use the Visual Basic programming language, they can be easily customized for other purposes. Once the screens have been translated into Visual Basic, the user can take advantage of its simplified programming language to make custom modifications. A list of other potential uses for the Visual Basic (VB) MMI screens is presented below, followed by more complete descriptions.

1. Use the VB screens for remote MMI applications.
2. Customize the VB screens to provide additional training information to the student during a simulation session.
3. Combine the VB MMI screens into a stand-alone package for training new operators on plant MMI screen navigation.
4. Interface the VB screens with other data networks at the work-site.
5. Interface the VB screens with a stand-alone Computer Based Training application.

The remote MMI concept is to simply interface the MMI screens with the actual DCS so that real-time plant data can be displayed on any PC workstation. This concept is outlined more fully in Ref. 1.

The second idea listed above allows the simulation training manager to incorporate additional information into the MMI screens to increase the value of the training session. He may, for instance, incorporate a procedure that monitors the student's actions, and reports an error if equipment is operated in some inefficient manner.

The third idea allows the MMI screens to be gathered into a package, and bundled as a Screen Navigation Trainer (SNT). The SNT is intended to operate on any low-end PC or laptop, and allows the new operator to practice navigating through the DCS Screens without using expensive DCS hardware. This option would be valuable to those sites where no plant specific simulator is installed or off-line training is desired.

An example of the fourth idea is to interface the MMI screens with a database of P&ID drawings. Thus, an I&C engineer would be able to click on a screen and obtain a list of all P&ID drawings associated with that display. This technique might be a useful alternative (not a

replacement) for existing Database Management Systems and search engines.

Finally, the fifth alternative, which is the focus of this paper, is to interface the MMI screens with a stand-alone Computer Based Training (CBT) application. The premise behind this idea is to use the MMI screens as a front end to the CBT. The student would use the plant specific MMI screens to navigate to the position in question, then use a special non-DCS command to activate the CBT application. By interfacing the plant specific MMI with the CBT application, the new student operator could learn how to navigate the plant MMI while participating in computer based training. Experienced operators, on the other hand, would be able to obtain information about the component in question without having to learn the CBT interface.

Approach

The approach to integrating the plant specific MMI screens with the CBT application is straightforward. First, the CBT scope must be decided upon and implemented; second, the MMI Screens must be integrated.

Development of the CBT application

Developing CBT using simulator MMI displays should proceed through the standard Instructional System Design (ISD) ADDIE (Analysis, Design, Development, Implementation, and Evaluation) cycle.

During the analysis phase instructional designs will look at the needs of the learners, using the results to plan the CBT program. For example, a large plant going through a DCS conversion and anticipating steady turnover in the next few years may require a navigation-oriented CBT application to get operators up to speed quickly while a smaller site with a more stable workforce can economically handle the orientation effort through classroom and On-the-Job-Training (OJT) sessions. Likewise, a centralized training facility, such as a technical college that uses simulators to support fundamental training for workers from plants with diverse operating environments may find great value in a standalone DCS Navigation CBT as a tool to quickly move learners past the mechanics of using the simulator so they can focus on the theory and fundamentals. In contrast, a utility company may want to include MMI displays in stand-alone or system-oriented CBT as a way to bridge the gap between theoretical material and the practical, on-the-job manifestations of theory in DCS readings.

During the design phase the training objective identified during the analysis phase are fleshed out into displays and interactions. The instructional designer makes decisions about when to fold CBT and other reference materials into MMI or simulator screens (in the form of pop-up help displays, Instructional Tutoring System (ITS) activities, or "See also" links) and when to fold MMI displays into CBT sequences. An example of the latter approach might be the use of a Turbine Control MMI display in a discussion of set point and safe operating ranges.

During CBT program development, the main task is executing the design in a particular CBT authoring package. Since the MMI screens are programs in their own right, integration with CBT applications usually means using one of two schemes:

1. Calling the CBT program from the MMI program, or
2. Calling the MMI programs from the CBT

This will not be an automatic function in any standard CBT authoring system, but most of the higher-end systems such as Asymetrix's Toolbook or Macromedia's Authorware system have intern programming or scripting features that allow programmers to build these types of links.

Once the integrated CBT-MMI application has been built, the Implementation and Evaluation phases of the ADDIE cycle are no different than for any other technology-based training program. Developers should test and evaluate the program in the full range of anticipated computer operating environments and with a full range of target audience members before distributing the integrated program for general use.

Integrating the MMI Screens

The first step in integrating the MMI screens into a CBT application is to obtain a set of DCS configuration files and translate the files into Visual Basic projects. The actual procedure for translation is simulation vendor specific. Currently, Framatome Technologies supports MMI translators for the Westinghouse WDPF Classic and Honeywell TDC3000 DCS systems. In addition, the feasibility of developing translators for other DCS systems is being evaluated.

Once the DCS files have been obtained and translated into Visual Basic projects, the user need only replace a few lines of code to convert the DCS MMI emulation into a CBT interface. Additionally, 'hot spot' targets should be identified and tied into specific CBT screens. Once these relationships have been defined, small modifications to the Visual Basic code will convert the VB MMI screen into a front-end for the CBT application.

Prototype Application

As a proof of concept, a prototype application was developed using a sample of the MMI graphics from the Carolina Power and Light (CP & L) Mayo Plant. The procedure used in the development of the prototype is identical to the procedure outlined above. Figure 1, presented below, identifies the major MMI screen used in the prototype project. Please note that Figure 1 has been modified, in order to accommodate the printed form, by reversing the black and white colors. Figures 2 and 3 represent samples from the CBT portion of the prototype project.

Conclusion

The MMI translators, initially developed to convert DCS specific MMI configuration information into stand-alone Visual Basic applications, are far more useful than initially anticipated. With a few simple keystrokes, the best MMI translators build complete Visual Basic projects from DCS configuration information without human intervention. The resulting Visual Basic projects can be easily customized to interface with other Computer Based Training applications. Now training managers have an affordable plant specific training solution that can grow with their needs.

References

1. W. Todd Sneed and G.F. Malan. "Remote MMIs – DCS MMIs Displayed on Remote PCs." 1996 International Fossil Simulation and Training Meeting – EPRI Supplement to the 1996 Proceedings of the 1996 Simulation Multiconference (New Orleans, LA, April 8-12, 1996).
2. Guideline for Computer-Based Training (CBT) Development, Volume 1 & 2, EPRI, Palo Alto, CA: 1998 TR110965-V1 and TR110965-V2.

TURBCOND

TURB COND

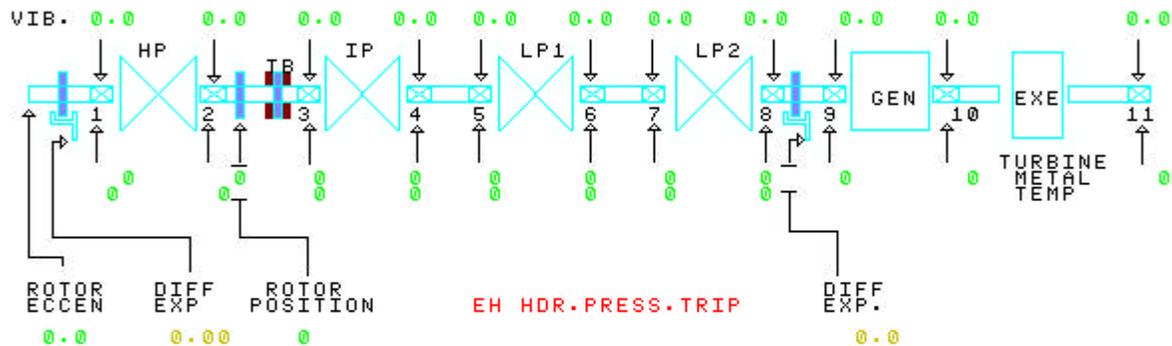
TEMP TRND

TURBINE CONDITIONS

VIB TRNDS

GEN CONDS

SPEED 0 RPM



| | | |
|------------|--------|-----|
| BAROMETER | PRESS. | 0.0 |
| THROTTLE | PRESS. | 0 |
| 1ST STAGE | PRESS. | 0 |
| STEAM SEAL | PRESS. | 0.0 |
| HP STEAM | TEMP | 0 |
| CRH STEAM | PRESS. | 0 |
| CRH STEAM | TEMP | 0 |
| HRH STEAM | PRESS. | 0 |
| HRH STEAM | TEMP | 0 |

VACUUM LOW TRIP

PHASE ANGLE

PM

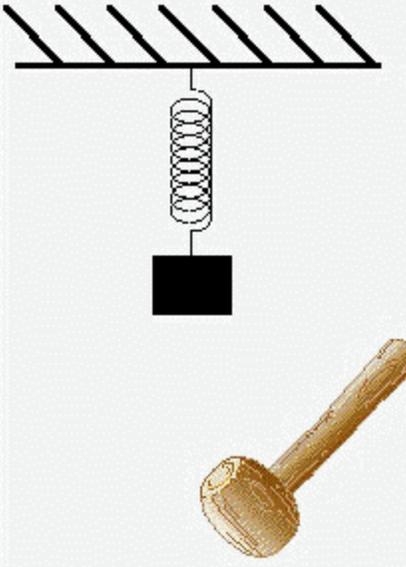
| | |
|--------------------|-----|
| X-0 TO LP PRESS. | 0.0 |
| X-0 TO LP TEMP. | 0.0 |
| A COND BACK/PRESS | 0.0 |
| B COND BACK/PRESS | 0.0 |
| TURB.LUBE OIL TMP. | 0.0 |
| LUBE OIL TANK LVL. | 0.0 |
| LUBE OIL TANK TMP. | 0.0 |
| BEARING OIL PRESS. | 0.0 |
| E.H.HEADER PRESS. | 0 |
| E.H FLUID TEMP. | 0.0 |

Figure 1. "TURBCOND" Turbine Conditions screen (B&W reversed)

Steam Turbine: Startup & Loading

Turbine Vibration

Basic Vibration Concepts



Vibration is the response of an object to some internal or external force. **Example.** ✓

- The "amount" of vibration of the object will vary with the **applied force** ✓ and the **resistance** ✓ of the object to the force.
- The "amount" of vibration is measured by:
 - ✓ 1. **Amplitude or displacement** – the magnitude of the vibration.
 - ✓ 2. **Frequency** – the cyclic rate in minutes or seconds.
 - ✓ 3. **Velocity** – the speed of mass movement during a cycle.
 - ✓ 4. **Acceleration** – the rate of change of speed during a cycle.
 - ✓ 5. **Phase** – how it is vibrating.
 - ✓ 6. **Frequency spectrum** – indication of more than one frequency of vibration.

Click on Forward to continue.

24010

Navigation controls: AUDIO (OFF/ON), REPLAY, PAUSE, EXIT, MENU, COURSE MAP, GLOSS, HELP.

Figure 2. CBT Screen Explaining Turbine Vibration

Steam Turbine: Startup & Loading

Turbine Vibration

Basic Vibration Concepts (continued)

Phase

Measures the relationship of vibration motion of one mass to another mass or location. Frequency phase relationships are used as a diagnostic tool for equipment troubleshooting.

90°

Object A

Object B

360°

1 Cycle

180° Phase Difference

Zero Phase Difference

←
→
AUDIO OFF ON
REPLAY
PAUSE

Click on Forward to continue.

24012

EXIT
COURSE MAP
GLOSS
HELP

Figure 3. CBT Screen Explaining Phase Difference