Shigeru TAKAYAMA[*]
Komyo KARIYA[*]

LEARNING METHOD OF MEASUREMENT ENGINEERING THROUGH USER NAVIGATION INTERFACE OF VIRTUAL INSTRUMENT

This paper describes the extensional function of user navigation interface of virtual measuring i n-struments which supports user's self-learning in experiment. The extensional function is presented by representation of knowledge database through internet browser. It is very effective for user to learn and investigation the knowledge of measurement engineering with training of operation of real or virtual measuring instruments in experience. The knowledge exploration by hyperlink through HTTP presents new heuristic learning method for user comparing with systematical learning method by lecture.

Keywords: user navigation interface, heuristic learning, virtual instrumentation

1. INTRODUCTION

In these days many functions, such as the communication, data display, data output, human interface, a memory, data processing in a measurement instruments system, and signal processing, are gradually taken in by improvement in the data-processing capability of a personal computer, and measurement system which can be customized comparatively free according to a user intention are used. As the processing of a sensor output is realized in the virtual world of a computer system, this system is known as a virtual measurement system.

The virtual measurement system is used especially by researchers or engineers as a professional engineering tool according to the predominance realized a signal/data processing, and conversion of a measurement result on the same platform, unified operability over many functions of a measurement system and the pliability of customi-

---

[*] Ritsumeikan Univ. BKC, Faculty of Science and Engineering, Dept. E. E. Engng., Japan,
e-mail: s- tkym@se.ritsumei.ac.jp

zation. However, this virtual measurement system is utilizable also as an educational training tool, for learning the method and principles of measurement

2. VIRTUAL INSTRUMENTS SYSTEM IN EDUCATION

Before, the system that acquires measurement data through a personal computer has been called the "Computer Assisted Measurement System". However, today's virtual measurement system is a total system initialized all the functions of measurement instruments through a graphical user interface in the virtual world by the remarkable improvement in the data-processing capability in personal computers and more digitization in measurement instruments. The usage is not only as a special software [1, 2] for a certain measurement instrument like Multimeter, Oscilloscope and Spectrum Analyzer, but also users are able to design an original function and system, and to make a flexible system on characteristics of measurement object acquired record output by performing a measurement simulation in advance. Tools including designs, such as LabVIEW [3, 4] and VEE [5], are standard used for designing of such virtual measurement system today. Based on many pliability of customization and various communication functions (IEEE488, VXI, RS232C/422, Field Bus, Ethernet, etc.) many extension design examples are reported on cooperation with various external instruments, connection with various network systems, remote control [6 - 9]. The virtual measurement system, which fully employed the feature of the virtual world and a communication function efficiently, is being widely utilized as a professional engineering tool that extended the capability of conventional measurement instruments deeply and broadly. The virtual measurement system enhances the usability by taking the operation of virtual world and employing the operation element of actual measurement instruments efficiently. This is one of the main factors that hare obtained many user's approval for a virtual measurement system.

The example that carries out virtual measurement system as a tool of various education or training has been reported by universities, the educational facilities of a company after 1992 [10] when a standard design tool is available now on GUI of an operating system [11, 12]. Generally, there are two kinds of style, in these applications. One is an application to use as a virtual system instead of an actual measuring instrument like the engineering tool mentioned above. In this case, user treats a known measurement object as an actual target for measuring. The application is used to lean physical characteristics of the known measurement object, design of measurement system, measuring method, monitoring and data processing in experiences of education and training [13 - 18]. Other is an application to use the virtual measurement system as a simulation tool in the closed virtual world in a computer. In this case, user treats a modeled virtual measurement object as an actual target for measuring [19 - 26]. The application is used to lean measurement systems, measuring methods, moni-

toring and data processing individually. As the application dose not need an actual measuring object, user can us this measurement system with a computer at any time and anywhere. Also, the virtual measurement system working on network environment is shown [22].

3. USER NAVIGATION INTERFACE

In the case that a virtual measurement system is used as an education tool, not a professional engineering tool, it is necessary for users to include support functions which they can lean measurement object, measuring method and construction of measurement system through the virtual measurement system. On an actual measuring instrument, the user support functions are presented by only paper materials except several poor icons and labels on a narrow operation panel. But, on a virtual measurement system, the user support functions are presented basically by various forms (windows, menus, boxes, sounds, pictures and animations) characterized in virtual world on the operation panel. And also, the user support functions in the virtual measurement system are present as a sequence like help, wizard and hyper link, not only individually. Moreover, as an aggressive support for users, the virtual system presents the user navigation function which stimulates a suitable operation of measuring instrument by showing operation procedures to users sequentially. User interface mounted the user navigation function has already realized in a port of measuring instruments.

Fig.1. Front panel of synthesizer mounted Key Navigation System
(WAVE FACTORY, NF Corporation)

Fig.1 shows a front panel of synthesizer (WAVE FACTORY, NF Corporation) mounted the user navigation function called "Key Navigation system" [26]. The synthesized has button keys (operation element) buried LEDs. User can recognize a next operation procedure easily by referring lights on the button key permitted to operate next. The user navigation function enhances the relationship (man-machine interface) between user and measuring instrument. The relationship grows up user's motivation on the measuring instrument. Fig.2 shows an example of the interface system instructed by assigning the man-machine interface supported the user navigation function to user navigation interface [27].
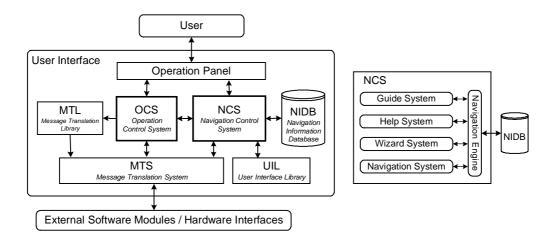

Fig. 2. Example of the construction of User Interface supported a User Navigation Function

This user navigation interface includes Operation Control System (OCS) and Navigation Control System (NCS). The OCS controls an operation input and a data/message output through an operation panel. The NCS observes a user's operation and presents information of operation procedures sequentially. To absorb an individual difference of fundamental software module and hardware interface, the OCS and NCS exchange message with them through Message Translation System (MTS). The MTS unifies forms and uses different operation element and their inter relations caused by various modules and versions of same kinds of measuring instrument and system. The user navigation interface presents the same operation panel and methods without effects by the difference of external measuring instruments, slot-in interface boards and their software drivers. Message Translation Library (MTL) is for the absorption of these individual differences. The MTL plays a role to supply a suitable module to MTS by the command from OCS that analyzes inconformity of message in MTS. User Interface Library (UIL) is a set of template of user interface correspondent

with a measurement object. The NCS refers an external database (NIDB) to generate the navigation information for an operation of measurement system. And it presents totally Guide, Help, Wizard and Navigation functions through a Navigation Engine. The guide function shows users an indication to operation elements, the role and an operation method sequentially. The help function presents the hyper reference concerned with the measurement system in general like measurement object, operation method of measuring instrument, results by such operation and meaning of parameter. The Wizard function presents a fundamental routine work of measuring instrument as a series of sequence. The Navigation function presents sequentially an actual operation procedure intuitively to user by using media parameters like an icon, a caster and an effect of operation element coloring, action and animation.

4.HEURISTIC LEARNING THROUGH USER NAVIGATION INTERFACE

Fig.3 shows a initial screen of user interface of Multimeter supported the user navigation function by NCS. In this user interface, there are four windows; Operation Window, Monitor Windows, Navigation Message Window and Educational Help Windows.
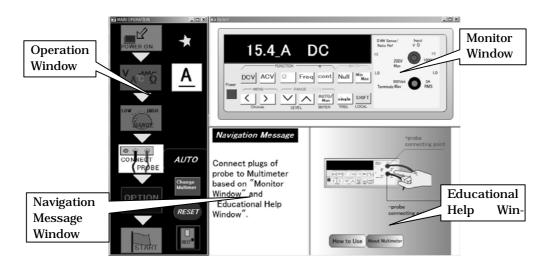

Fig.3. Initial screen of User Interface of multimeter

The Operation Window shows a sequence in order for user to control the virtual Multimeter. The Navigation Message Window displays the brief explanation of the next procedure for user. Use can confirm the next operation by highlighted icon and

such the explanation. The Monitor Window shows Key Navigation of operation procedure on graphics of real Multimeter. The Educational Help Window shows a general manual of Multimeter. The window is made by internet browser. And also, by including an extended function, the window presents related topics of measurement engineering through the operation of Multimeter. Then the extended function is realized by Hyperlink Engine and Knowledge Database of measurement engineering. Fig.4 shows the relation around the Help System in NCS of Fig.3 User can investigate soon about topics he had interesting in experience or operation of user navigation interface. And also he can know easily and quickly other related topics from the topics. This is different with systematical learning method. But, this learning method become very effective by reason of obvious motivation and high intuition grown through experience of measuring. It is considered that the browsing of hyperlinked individual knowledge is a kind of heuristic learning method. In this heuristic learning, user become active to learn. To know a systematical knowledge, user must reconstruct the knowledge collected by the heuristic learning. It is consider that lecture is the most helpful for user to do it. Synchronizing with the systematical learning by lecture, this heuristic learning through user navigation interface of virtual instrument takes an important and effective role to learn the measurement engineering.
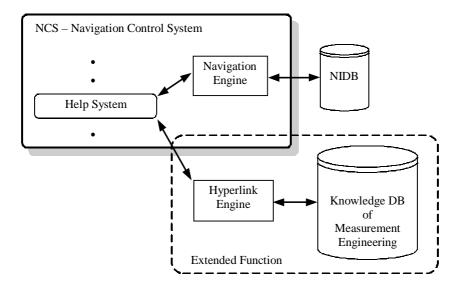
Fig.4. Initial screen of User Interface of multimeter

5. CONCLUSIONS

Virtual instrumentation has various potential ability for engineering education. They are not only numerical calculation, image processing, data communication but also various kinds of user interface of knowledge presentation. This paper has shown user navigation interface as a characteristic presented by virtual instruments. And also, it has shown that an extension function (Educational Help Window) of the user navigation interface become a gateway to knowledge database of measurement engineering.

REFERENCES

[1] http://www.mci.panasonic.co.jp/nws/article/1995_37_5.html.

[2] http://www.yokogawa.co.jp/Measurement/Bu/Welcome.html.

[3] http://www.ni.com/.

[4] National Instruments™ General Catalogue 2000, *The measurement and automation*.

[5] http://www.agilent.com/

[6] POTTER D., *Using Ethernet for Industrial I/O and Data Acquisition*, Proc. 16th IEEE IMTC , 99, 1492-1496.

[7] FORTINO G., NIGRO L., *Multimedia networking-based approach to the development of distributed virtual instruments*, Proc. 16th IEEE IMTC 1999, 99, 1863-1867.

[8] OLDHAM N., PARKER M., *Internet-based test service for multifunction calibrators*, Proc. 16th IEEE IMTC 1999, 99, 1485-1487.

[9] SANDU F., SZABO W., BORZA P. N., *Automated measurement laboratory accessed by internet*, Proc. of XVI IMEKO World Congress, Vol. 2, 111-116, 2000

[10] http://www.ni.com/company/history.htm.

[11] BASILICCO E., MICELI R., MILLEMACI S., NUCCIO S., GALLUZZO G. R., TRAPANESE M., *A teaching laboratory on automatic tests systems*, Proc. of XIII IMEKO World Congress, Vol. 1, 38-43, 1994.

[12] E.KAYAFAS, I.TSATSAKIS, V.LOUMOS, E.CAMBOURAKIS : *Electronics, Metaphors and Multimedia. An Innovative Tutoring Environment*, Proc. of XIII IMEKO World Congress, Vol.1, 58- 62, 1994.

[13] REFEROWSKI L., ROSKOSZ R., SWISULSKI D., *Progress in lecturing of electrical measurements using virtual instruments*, Proc. of XIV IMEKO World Congress, Vol. 2, 19-24, 1997.

[14] SWEDROWSKI L., *Teaching of the electrical motors diagnostics*, Proc. of XIV IMEKO World Congress, Vol. 2, 47-52, 1997.

[15] KADIONIK P., ZIMMER T., DANTO Y., *RETWINE: a new distributed environment for microelectronics instrumentation learning and measurement*, Proc. 16th IEEE IMTC 1999, 99, 1488-1491.

[16] GROZA V., *High resolution floating-point analog-to-digital converter*, Proc. 16th IEEE IMTC 1999, 99, 1663-1666

[17] NUMMIEN M,, AUMALA O., *Virtual iInstrument as AC measurement training tool*, Proc. of XVI IMEKO World Congress, Vol. 2, 85-89, 2000.

[18] PODGORSKI A., WISNIEWSKI K., *DSP evaluation module usage in students laboratory*, Proc. of XVI IMEKO World Congress, Vol. 2, 91-97, 2000.

[19] BERTOCCO M., FERRARIS F., OFFELLI C., PARVIS M., *Training of programmable instrumentation: a student laboratory*, Proc. of XIV IMEKO World Congress, Vol .2, 13/18 (1997).

[20] ROOIJ C., *An object oriented education program in measurement and instrumentation*, Proc. of XV IMEKO World Congress, Vol. 2, 15-22, 1999.

[21] BENETAZZAO L., BERTOCCO M., NARDUZZI C., OFFELLI C., *Object oriented techniques in a flexible higher education and training laboratory*, Proc. of XV IMEKO World Congress, Vol. 2, 23-30, 1999.

[22] BERTOCCO M., FERRANIS F., PARVIS M., *A remote and distributed student laboratory*, Proc. of XV IMEKO World Congress, Vol. 2, 61 -67, 1999.

[23] DRNOVSEK J., BOJKOVSKI J., PUSNIK I., TASIC T., *Automation of a precision temperature calibration laboratory*, Proc. 16th IEEE IMTC 1999, 99, 1883-1887.

[24] AUMALA O., *Hypertext training aid in measurement technology*, Proc. of XVI IMEKO World Congress, Vol. 2, 9-14, 2000.

[25] .MURAVYOV S. V, V.KOMAROV A., SAVOLAINEN V., *Graphic measurement programming and creation of laboratory works for engineering education*, Proc. of XVI IMEKO World Congress, Vol. 2, 73-78, 2000.

[26] http://www.nfcorp.co.jp/wavefact/nfa00.html.

[27] S. TAKAYAMA, KARIYA K., *User interface of measuring instruments on engineering education*, Proc. of XVI IMEKO World Congress, Vol. 2, 123-127, 2000.