Heuristic Learning Tool on User Interface of Virtual Instrument

S.Takayama, K.Kariya

Department of Electrical and Electronics, Faculty of Science and Engineering,
Ritsumeikan University BKC, Noji, Kusatsu, Shiga Japan
Email: s-tkym@se.ritsumei.ac.jp, kariya@se.ritsumei.ac.jp

Abstract. *Virtual instrument is the system to operate the task of measurement, data processing, monitoring and system control on one virtual platform. The remarkable characteristics are on the integration and the flexible customization. Therefore, the virtual instrument has been used by researchers and engineers as a professional engineering tool. However, by using various features of virtual world, the virtual instrument is utilized as an educational tool for students to learn measurement principle, measuring object, operation method of system and various topics concerning to the measuring. By using at experiments in education, it is expected that the learning through virtual instrument enhances intuition and motivation of students to measurement engineering. This paper describes the construction and characteristics of the educational tool by virtual instrument.*

Keywords: Virtual Instrument, Heuristic Learning Tool, User Interface

1. Introduction

By the remarkable improvement of data processing ability of personal computer and the digitalization of measuring instrument, virtual instrumentation becomes a total system realized all functions of measuring instrument through a graphical user interface. The usage is not only as software for a special measurement instrument like Multimeter, Oscilloscope and Spectrum Analyzer. User is able to design an original function, to simulate a system before the measurement and to construct the flexible system to characteristics of measurement object, data processing and human interface. To design the virtual instrumentation system, LabVIEW and VEE are used as a standard. Based on flexibility of customization and various communication functions (IEEE488, VXI, RS232C/422, Field Bus, Ethernet, etc.), many extended systems(cooperative system, network system, remote control) are reported[1]. By using a feature of the virtual world and a communication function efficiently, the virtual instrumentation system has been widely utilized as a professional engineering tool which extended the capability of actual measurement instruments deeply and broadly. Also the system enhances the usability by taking the characteristic operation element of virtual and real world efficiently. On the other hand, the virtual instrument becomes an effective education tool by including an extended function to a hyper linked page and a HTTP browser.

2. Virtual Instrument as an Educational Tool

Examples of the use of virtual instrument as an educational tool have been reported after 1992[2]. These days, a standard design tool is available now on GUI by operating system. Generally, these applications are classified into two kinds of style. One is an application to use as a virtual system instead of an actual measuring instrument like an engineering tool mentioned above. In this case, user treats a known measurement object as an actual target to measure. The application is used to learn physical characteristics of the object, design of measurement system, measuring method, monitoring and data processing by experiences in education and training[3]. Other is an application to use as a simulation tool in a closed virtual world. In this case, user treats a modelled virtual measurement object as a target to measure. The application is used to learn measurement system, measuring method, monitoring and data processing individually[4]. As the application dose not need an actual measuring object, user can use this system at any time and anywhere. Also, the virtual instrumentation system working in a network environment is shown. In the case that a virtual instrumentation system is used as an education tool, not a professional engineering tool, it is necessary to include an user support function which they can learn measurement object, measuring method and construction of measurement system through the virtual system. And in experiences and self learning by the system, user can learn system operation by confirmation of an operation element on panel, a meaning of parameters, an operation method and the effect. By the learning, it is expected for user to understand a measurement object and system more deeply and widely. The user support function of

an actual measuring instrument is presented by only paper materials except several a poor icon and label on narrow operation panel. But, the function of a virtual measurement system is presented by various forms (windows, menus, boxes, sounds, pictures and animations) characterized in virtual world on the operation panel. And also, the function is presented as a sequence of help, wizard and hyper link simultaneously. Moreover, as an aggressive support for user, the virtual system presents the user navigation function which encourages a suitable operation of measuring instrument by showing an operation procedure to user sequentially. User interface mounted the user navigation function has already realized in a part of measuring instruments.

3. User Navigation Interface

Fig.1 shows an example of the user interface supported user navigation function. This user navigation interface has two main system that are Operation Control System (OCS) and Navigation Control System (NCS). OCS controls an operation input and a data/message output through an operation panel to user. NCS observes user's operations and presents information of suitable operation procedures sequentially. To absorb an individual difference of fundamental software module and hardware interface, OCS and NCS exchange message with them through Message Translation System (MTS). MTS unifies a form of message. And it uses an individual operation element and inter relation each module and version. The user navigation interface presents the same operation panel and methods without various 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. MTL plays a role to supply a suitable module to MTS by the command from OCS that analyzes according to message in MTS. User Interface Library (UIL) is a set of template of user interface correspondent with a measurement object. 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 an operation element, role and an operation method sequentially to user. The help function presents the reference concerned with measurement like measuring object, operation method, measuring result and parameter. The Wizard function presents a fundamental routine work of measuring instrument as a series of sequence. The Navigation function presents sequentially an operation procedure intuitively to user by using media parameters like an icon, a caster and an effect(color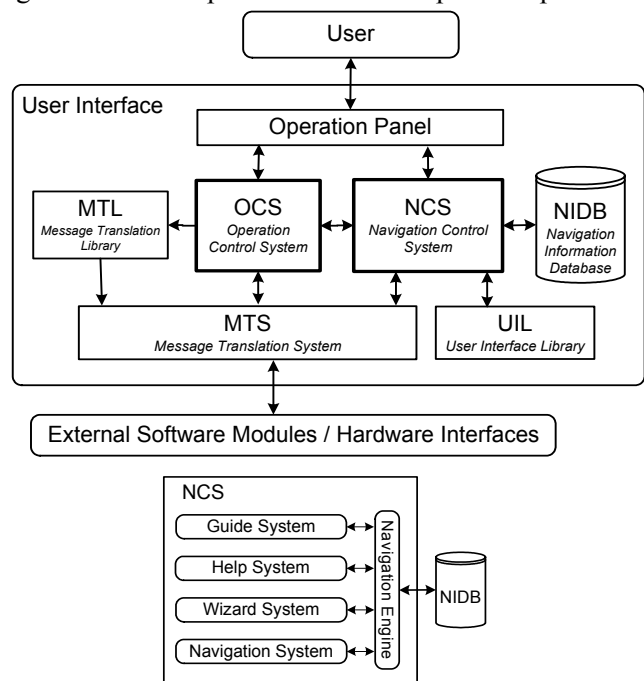, action, animation) of operation element. Fig.2 shows an initial screen of the user interface of Multimeter supported the user navigation function by NCS. In this user interface, there are four kinds of window; Operation Window, Monitor Window, Navigation Message Window and Educational Help Window. The Operation Window shows a sequence of procedures for user to control the virtual Multimeter. The Navigation Message Window displays the brief explanation of next procedure for user. User can confirm the next operation by a highlighted icon and the explanation. The Monitor Window shows Key Navigation of operation procedure on graphical front panel simulated a real Multimeter. The Educational Help
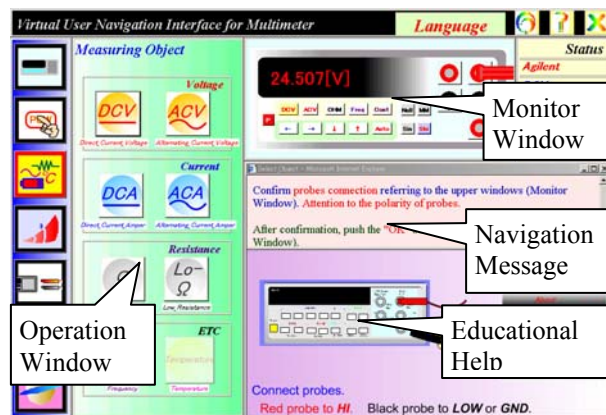

Fig.1. System Construction of User Interface supported Uses Navigation Function

Fig.2. User Navigation Interface for Multimeter

Window made by a HTTP browser shows various kinds of information how to use a Multimeter and user navigation interface. To operate a Multimeter, usually, the window shows operation information and a general manual of Multimeter. And also, by including an extended function, the window presents topics related an operation of Multimeter based on measurement engineering. The extended function is realized by Hyperlink Engine and Knowledge Database concerning to the measurement engineering.

4. Heuristic Learning on User Interface

Through the Educational Help Window, user can investigate soon about the topic he has interesting at the experience or operation of user navigation interface. And also he can know easily and quickly other related topics from a topic. Fig.3 shows the example of transition of windows at learning by the Educational Help Window. User changes to the window shown "Alternative Current(AC)" by selecting an item "AC" on the window shown "introduction of Digital Multimeter". And he changes to the window shown "Voltage" by selecting an item "Voltage" on the window shown "AC". And also he changes to the window shown "Digital Signal" on the window shown "Voltage". As these windows are interactive, he can also learn the relation between the topics. This learning method is different with systematic method. But, this method becomes very effective by the obvious motivation and high intuition grown through experience of measuring. This method by browsing hyperlinked individual knowledge is a kind of heuristic learning method. In this heuristic learning, it is expected that user becomes more active to learn an instrument, a measuring method and a measurement principle. It is sure that, to know a systematic knowledge, user must reconstruct the knowledge collected by the heuristic learning. Lecture is the most suitable learning style to do it. Synchronizing with the systematic 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 shows fundamental concepts of the heuristic learning on the window and the systematic learning. Item is a learning content written in each window. Those items are classified into several categories according to their characteristics. Dotted line means a hyper linkage between the items. Through the hyper linkage, user is able to find the learning content next to next. The transition is different each user by reason of initial knowledge, interest, intuition and motivation. Some of the transition is over a category. Fig.5 shows the example which accesses the window of fundamental topic related measurement engineering by a list tree. The topics classified to some categories by the list tree are very convenience and valid for users to find the item he interests. In addition to the method by Hyperlink shown in Fig.3, this visual educational tool presents effective learning method for them.
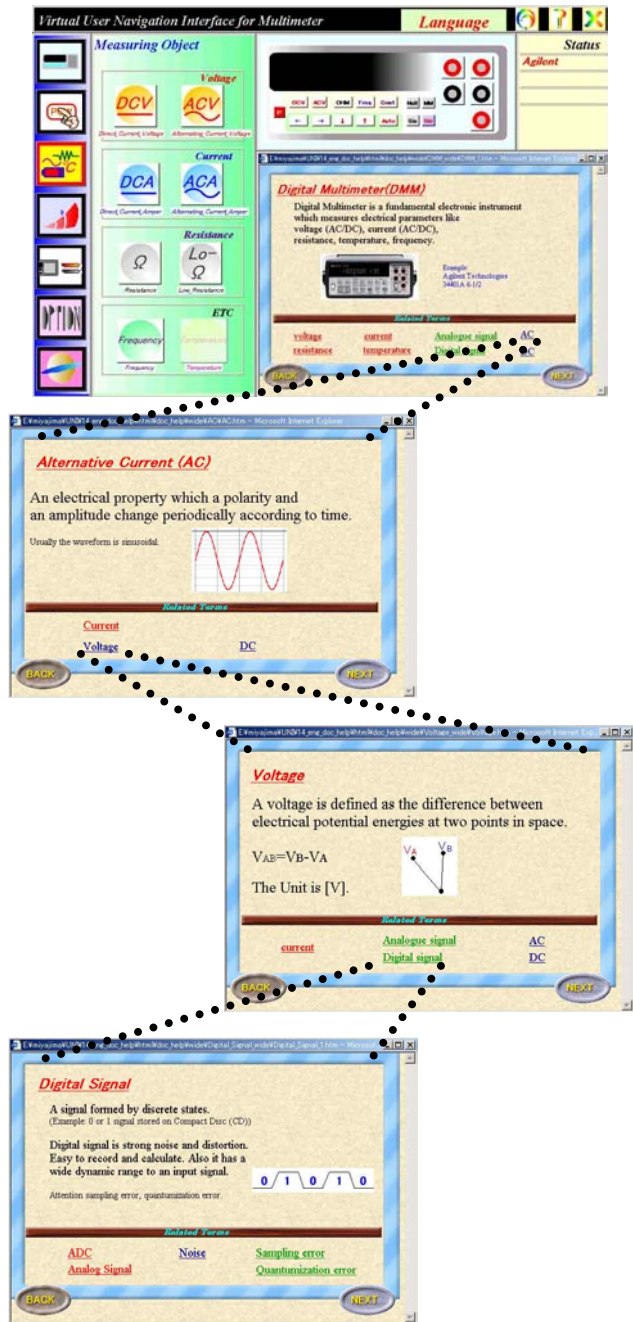

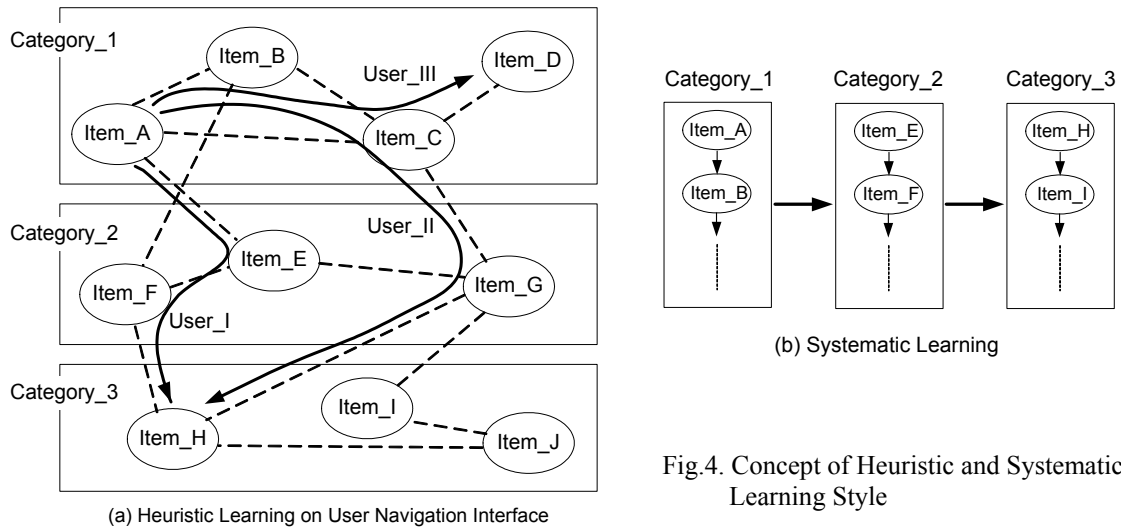Fig.3. Example to Transition of Windows at Learning by Educational Help

(a) Heuristic Learning on User Navigation Interface

(b) Systematic Learning

Fig.4. Concept of Heuristic and Systematic Learning Style
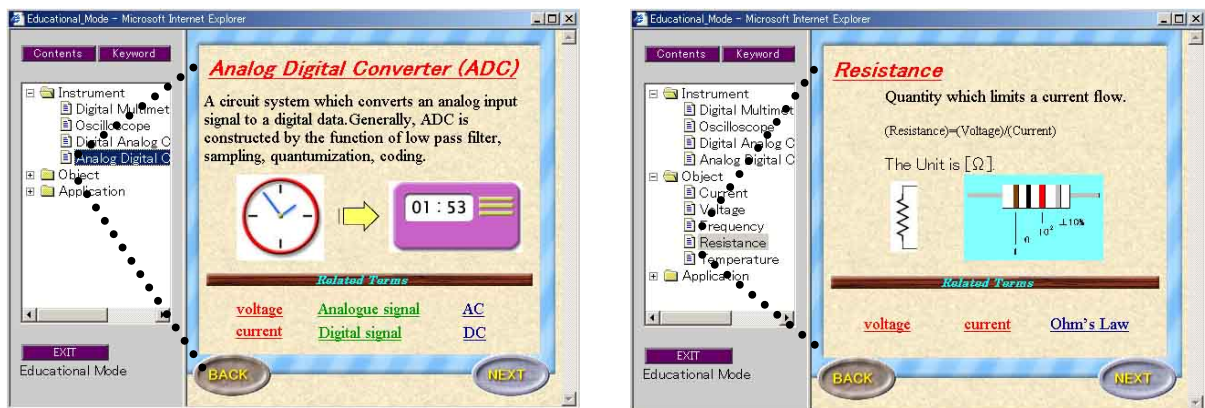

Fig.5 Examples of Window presented by a List Tree

5. Conclusions

Virtual measurement system has been recognized as the total system expected to enhance flexibility, portability, and cost-effectiveness of the measurement by representing an actual measuring instrument. And also, by using a characteristic of virtual world enough, the virtual instrument becomes a flexible and effective education tool. User navigation interface(UNI) is an user assisted function on the user interface of virtual instruments. By navigating the operation procedure, the UNI enhances easiness to use for user. And also this paper has shown a visual learning function for user by using the Help Window on UNI. The Help Window has been also redesigned as an Educational Help Window by using a HTTP browser. The window presents the related topic of virtual instrument and the topic derived from the instrument. As those topics are expressed by HTTP, they are connected by a hyper linkage. At an experiment in education, user can learn an operation of Multimeter and know the related topics, terms and items. And at self-learning by UNI, he can investigate soon about interesting topics. It is expected that this heuristic learning method grows up effectively the obvious motivation and high intuition of user through experiences and self learning.

References

[1]   D.Potter:*Using Ethernet for Industrial I/O and Data Acquisition*, Proc.16[th]IEEE IMTC/99,1492-1496,1999.

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

[3]   L.Swedrowski:*Teaching of the Electrical Motors Diagnostics*, Proc.of XIV IMEKO World Congress,Vol.2,47-52,1997.

[4]   M.Bertocco, F.Ferranis, M.Parvis:*A Remote and Distributed Student Laboratory*, Proc.of XV IMEKO World Congress,Vol.2,61-67,1999.