

The Study of Internet Applications in LabVIEW Teaching

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Abstract: - This study is proposed to discuss the application of graphical programming software of LabVIEW (Laboratory Virtual Instrument Engineering Workbench) and the integrated interface technology of control system for development board through Internet teaching. Students can operate the lab computers to write programs and learn to utilize education board via the remote desktop built in the Windows operating system. Students can also observe immediately if their operation is accurate and if they can meet the requirements of each exercise with web cameras, designed in this study to achieve the teaching purpose of the integrated courses in LabVIEW system. Through the internet, students who have no lab equipment and software at home can not only learn early without the limitation of time and space, but also obtain curriculum efficiency to enhance career ability.

Key-Words: - LabVIEW; Education board; Internet; Online learning

1 Introduction

The ubiquitous Internet and the well-developed World Wide Web have enabled lecturers and learners to participate teaching and learning activities through Internet; therefore, the delivery of knowledge and interchange of learning information have also changed. Widespread Internet changes the role of teacher from a lecturer to a counselor, a partner, as well as a learning information provider. The lecture of internet teaching is that students start to control the scheduled progress by their own with teachers' assistance. The teaching environment has been changed from the traditional classroom in the real world to a networked virtual learning world[1-3].

With the advanced development in Internet techniques and applications today, the applications based on Internet system have also developed boarder and boarder. Since today's Internet has become comprehensively utilized, and that the environment can be used to create a totally novel teaching method on the Internet, this study is designed to teach learners with the remote desktop included in the Windows operating system through the network on desktop. This can help to resolve the problem that students may have no software and equipment, plus, it is beyond time and space limit so the learning efficiency and convenience can be elevated. Students can operate the computers of the lab to write programs and to learn development board of education via the remote desktop built in

the Windows operating system in this study. Students can also observe immediately if their operation is accurate and if they can meet the requirements of each exercise through front panel of LabVIEW designed in this study and web cams of the computers, and thus the teaching purpose of the integrated courses in LabVIEW system is achieved.

2 Course of Objectives

LabVIEW is developed by Jeff Kodosky of National Instruments Cooperation in the mid year of 1986, and the teaching content of the study mainly discuss the 7.0 version. The integrated practical courses of LabVIEW are proposed in the study to provide for the college students as their required course or graduate students as their elective course for integrated system. The study is to prepare the recognition of future research work for the students who are willing to be dedicated to research work in the future; and therefore, students are expected to have the capabilities as follows :

- A. Understanding the purposes of the graphic monitoring program and the significance of learning LabVIEW
- B. Understanding the basic structure and basic functions of the LabVIEW program
- C. Understanding the signified meaning of the virtual graphic instrument and its figure
- D. Being familiar with the usage of virtual graphic instrument toolkit and its functions

- E. Being capable of illustrating the structure and function of the dialogue box in the virtual graphic instrument
- F. Understanding the decoding and encoding design skills of the word string data sequence
- G. Being equipped with the basic ability of knowing the ASCII data encoding and control command combination
- H. Understanding the circuit structure and application functions of the development board of education
- I. Understanding the theory of LED matrix and the program scanning application techniques of micro processor
- J. Being familiar with the basic concept of graphical programming software and development board of education integration
- K. Being familiar with the writing of high and low level programming language and the firmware integrated techniques
- L. Being familiar with the Internet application

3 Course Structure

3.1 Course Content and Teaching Methods

The total duration of the course “The integrated practical course of LabVIEW system” lasts for 18 weeks. During the first 12 weeks the lecturer instructs students with textbook on the basic concept and development board of education content, and for the last 6 weeks students have to operate the computers in the lab via the remote desktop, besides, students also have to verify if their operating procedures of the development board of education are accurate through the web cam in the computer lab. Lecturer of the course has to monitor students’ learning conditions by means of pop quizzes, tests, assignment, and reports, for the future teaching improvement references. In the midterm and final, lecturer may give students exams to verify and evaluate their learning performances.

Besides, before the course commences, an HFS teaching information platform has to be established on the Internet, which includes the course outline introduction, exercises, online teaching for students to practice repeatedly. Other than that, assignment uploading is also included in this teaching platform for students to upload their scheduled reports and for lecturer to assess students’ grade point average and to pronounce teaching information of the course in the bulletin board. The biggest purpose of the study is to provide students an accessible course anytime anywhere for their preview, practice, and review beyond the boundary of equipment, software, and time when they are learning. And at the same

time, students of the course can learn and comprehend the course comprehensively and completely. The content of the course is shown in TABLE 1 as follows :

TABLE 1 CONTENT OF THE COURSE

Course week	Content of the Course
The first 12 weeks	<ol style="list-style-type: none"> 1. Learning installation of the LabVIEW program, single-step program operation, and breakpoint setup 2. Practicing the programming language design of the single chip microprocessor 3. Practicing the integrated application of high-level graphical programming software and low-level teaching development 4. Being familiar with the hardware circuit mode setup of the development board of education
The first 12 weeks	<ol style="list-style-type: none"> 5. Being familiar with the programming design techniques of the Interrupt Service Routine of the micro processor 6. Being familiar with the matrix LED display and array scanning technology 7. Learning the development board of education data transmission and control code compilation 8. Being familiar with the human machine interface integration and project design procedure
The last 6 weeks	<ol style="list-style-type: none"> 1. Practicing each loop structure, Boolean Operation, and matrix chart usage and data type definition 2. Property and function configuration of virtual instrument component tool 3. Subprogram application, data type definition, control code compilation and ASCII hex conversion 4. Learning serial transmission(RS232、USB), and to create executable file(EXE)
Assessment test	Lecturer of the course has to monitor students’ learning conditions by means of pop quizzes, tests, assignment, and reports, for the future teaching improvement references. In the midterm and final, lecturer may give students exams to verify and evaluate their learning performances.

3.2 LabVIEW remote desktop connection

WWW, short form of World Wide Web, is also known as Web. Most academic institutions have installed Microsoft operating system and therefore, each user may access to browse and to use without extra burden of the copyright fee through Web and via remote desktop connection which is built in the Windows. Students have to access to the computers in the remote computer lab with computer network address and password that are authorized by the instructor of the course. The Picture of Remote Desktop Connection is shown as Fig.1.

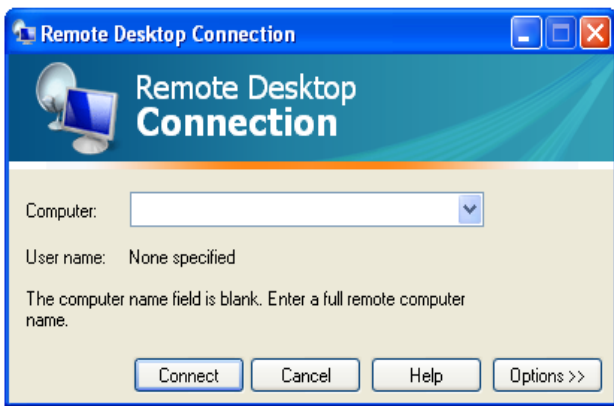


Fig.1 The Picture of Remote Desktop Connection

3.3 Remote Webcam Monitor

With Windows operation system and web cam available in the market, remote webcam can be opened and can be used to transmit dynamic video via the remote desktop connection on the Internet. As long as students have local area network (LAN), dial-up network, or wireless network, they can connect and operate the web cam.

3.4 LabVIEW and the connection of the development board of education

USB interface is used between the LabVIEW and development board of education for command encoding transmission and then the control command is given by decoding the corresponding codes. Therefore, students are allowed to transmit data via the communication port of the development board of education connected to the server computer of lab. The IC of the USB interface will transmit date and communicate with the COM port of the computer and will be connected to the control single of the development board of education. USB interface of a computer is used with 5V/500mA power supply without extra power source so it is energy-saving and it can promote the convenience and performance in teaching. Fig.2 is the teaching system connections shown as follows :

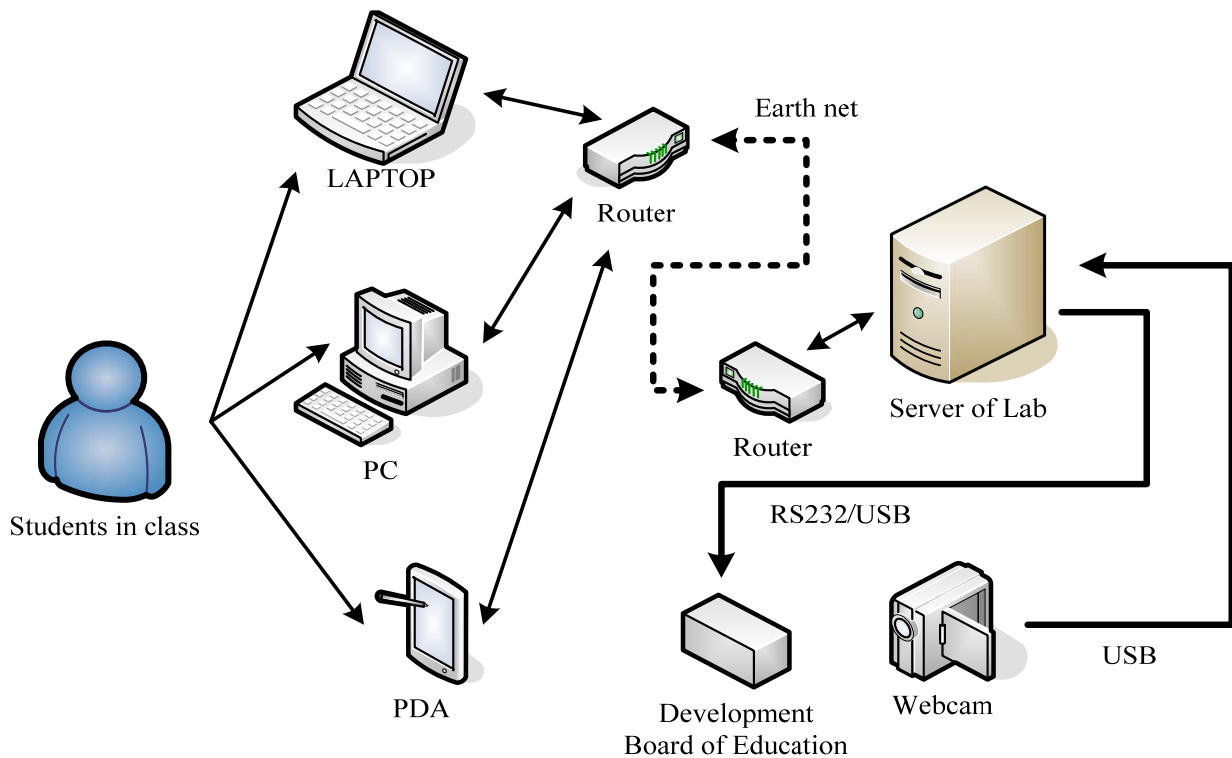


Fig.2 Teaching System Connections

3.5 Forum and Website Establishment

Teaching platform is established by applying the HFS (Http File Server) software authorized by Free Software Foundation, Inc. The software is a HTTP file server, suitable for the use in the Windows operating system. And it allows user to create file sharing system that can be served as an upload and download system with browsers, shown as Fig.3 According to the planning content of the course, the teaching platform includes outline introduction and learning objectives and exercises and online teaching examples for students to practice, assignment uploading for students to upload learning report, as well as course notice. Fig. 4 is the teaching platform connection picture of the course. Fig.5 is the username and password confirmation picture that students login onto the server.

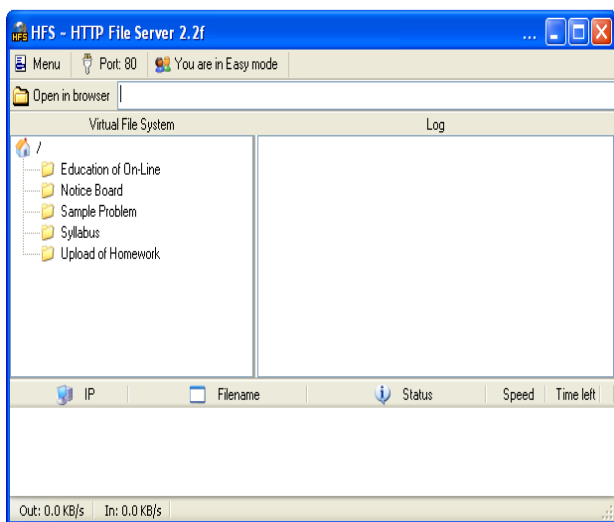


Fig.3 The Picture of Platform Setup and Configuration of Http File Server

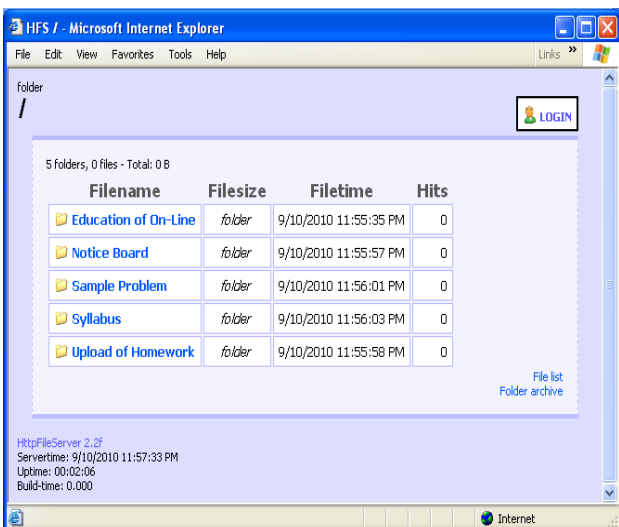


Fig.4 The Connection Picture of the Teaching Platform of the Course



Fig.5 The Picture that Students login onto the Server with Username and Password

3.5 LabVIEW Software Introduction

LabVIEW is developed by Jeff Kodosky of National Instruments Cooperation in the mid year of 1986. LabVIEW is an application software tool mainly featuring its virtual instrument control. The graphic interface replaces the traditional text-based interface and built-in subprograms and instrument drivers, object-oriented and flowing chart frame are designed for human machine interface communication through DAQ cards, which all proved LabVIEW is a powerful and highly adaptable instrument control and analysis software. LabVIEW programming design is mainly divided into two parts [4-6] :

1) Human machine interface (Front Panel):

Front Panel is a tool used for observation from the configuration input value and programming dialogue box flowing chart output value. Since the front panel is similar to the real instrument board, its input is also called Controller, and its output Indicators. Users can use different Controller and Indicators such as buttons, charts that are easy to understand. It can be used not only to simulate switches, initial value and threshold limit value configuration, and it also can be used to display the output results onto the board. Refer to Fig.6, the picture of the Front Panel.

2) Block Diagram :

Inside Front Panel, Block Diagram flowing charts are attached, a program of virtual instrument (VI). Users may use picture-like design to build block diagram and the procedure node is presented by constituting block diagram such as for loop, case and calculation function and so on. Lines can be used to connect each constitute and therefore, data is

connected for transmission. Diagram contains the low-level VI, built-in functions, constants, and controlling programming performance and so on. After each diagram is connected to one another the program is formed to be used. See Fig.7. Block Diagram.

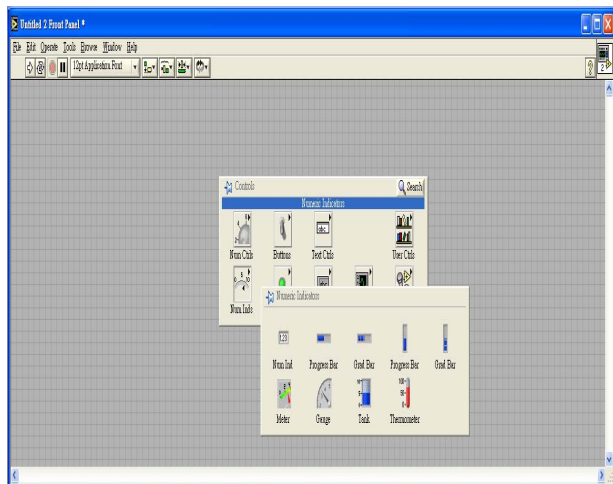


Fig.6 Front Panel

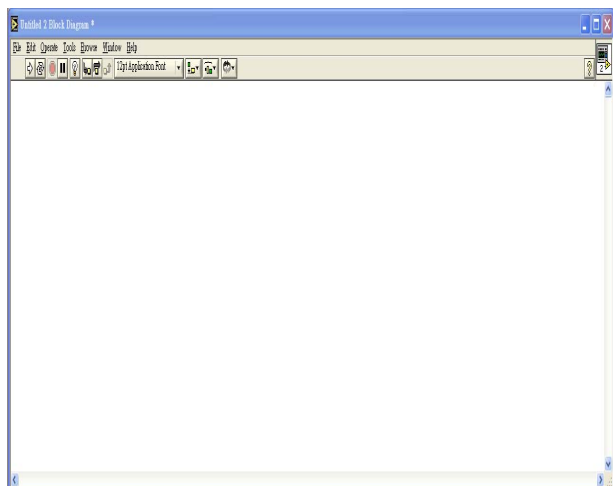


Fig.7 Programming Block Diagram

4 A Model Demonstrating Teaching Steps

The remote control of the study shows the local computer in the lab which is installed with LabVIEW software is accessed by remote-end students using remote desktop connection. Students may download basic theories introduction and practice examples to practice LED matrix control program in the teaching exercise. The programming design content mainly focuses on LED matrix display pictures, fonts, and digit numbers. Users write dynamic pictures to switch to control command codes. After the programming design and data encoding are finished, users download data

serials to the development board of education via USB and RS232 interfaces and verify if the LED display pictures is accurately performed through control programs via webcams.

The matrix picture on development board of education is constituted by many LED. To display the picture of LED matrix to meet the preplanned requirements, LabVIEW can be used to simulate the display picture. This paper provides students with a complete teaching example to guide students to follow this model to complete experiment practice. The teaching model shows a 8×8 matrix, but students may increase matrix points such as 8×16 or 16×16 matrix depending on their different learning performance. The teaching model is illustrated as follows:

Step 1 :

Arrange 8×8 matrix picture and indicate the corresponding positions by means of LabVIEW signal display switch. When students design the programs, they have to plan the display data and download the word string data to the same picture presented in the development board of education as the picture shown in LabVIEW. The matrix picture design is shown as Fig.8 (Example 1).

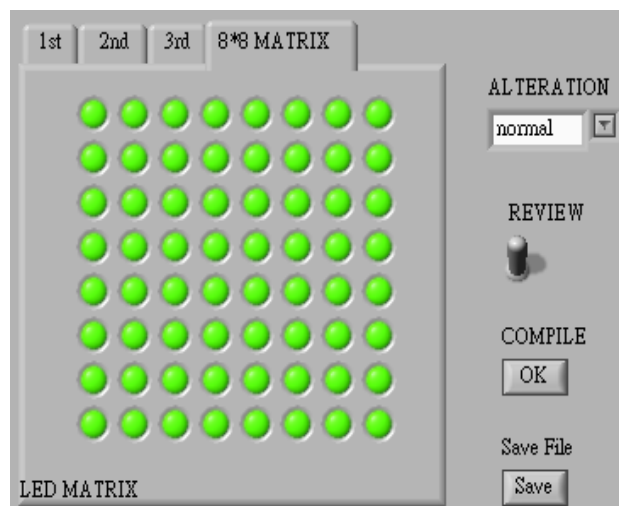
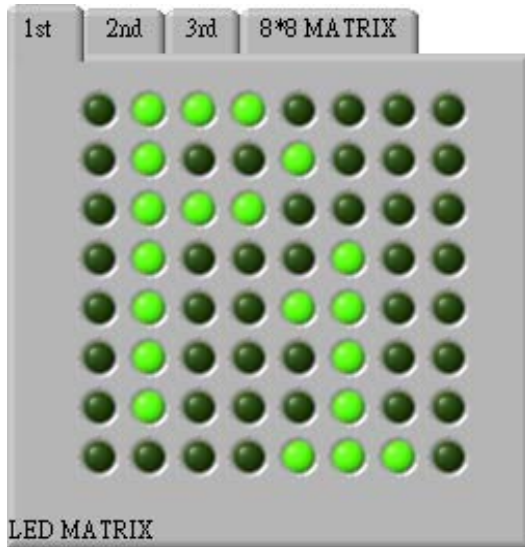


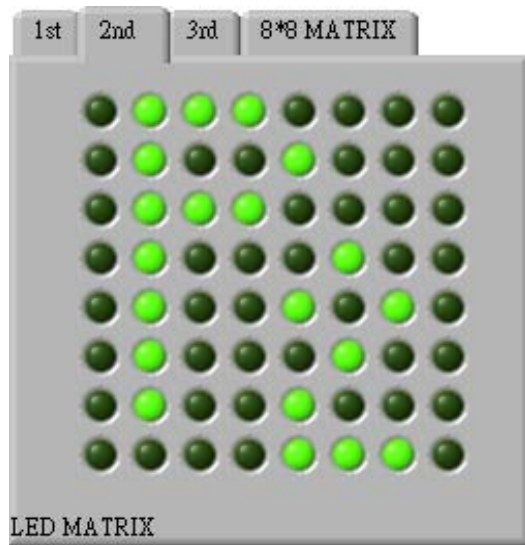
Fig.8 Matrix Picture Design Panel (Example 1.)-
Display Picture Planning

Step2 :

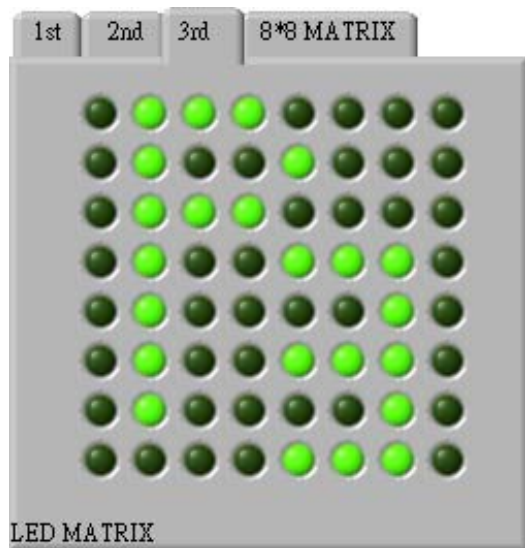
Design LED matrix display page numbers and display content of each picture. The teaching content in the paper shows the three-page matrix picture as the teaching performance assessment. Lecturers may adjust based on student's condition. The matrix picture design is shown as Fig.9 as follows :



(a) Page 1st.



(b) Page 2nd.



(c) Page 3rd.

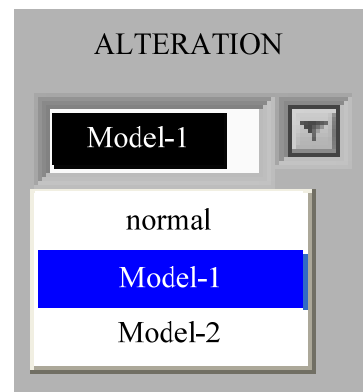
Fig.9 Matrix Picture Design Panel (Example 2.)-
Picture Choice Planning

Step3 :

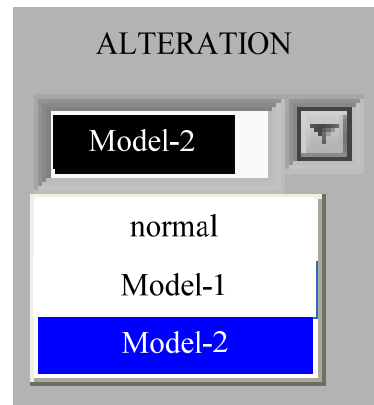
Based on the content of Step2, students need to map out the dynamic display method of page number switch in programming design. In the example, two models are shown to be the function1 (Model1-1) fadeout and zoom, and the function 2 (Model 1-2) fadeout one by one respectively, which are similar to the switching methods of the Power Point slides. In the option setup defined by this paper “F1” presents the function 1, and “F2” function2. Matrix picture design panel is shown as Fig. 10(Example 3.) as follows :

Step 4 :

In the example, students can browse matrix display picture and transform ways by means of the functions in LabVIEW dynamic picture display. Also, the smoothness and sense of beauty of the design pictures can be used as criteria to guide other students’ designs. The matrix picture design panel is shown as Fig.11(Example 4). “REVIEW” presents browsing display function, “COMPILE” means switching matrix display picture by encoding the data to word string data, while “Save File” indicates the file-saving button.



(a) Quick Page-Switch



(b) Movement Disappearance

Fig.10 Matrix Picture Design Panel (Example 3.)-
Switching Model Planning



Fig.11 Matrix Picture Design Panel (Example 4.)- Picture Preview

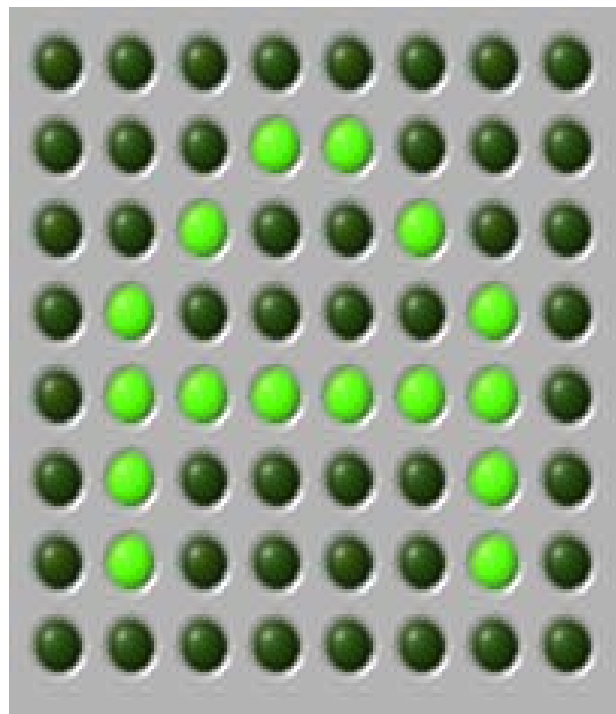
Step 5 :

Through the LabVIEW design display picture, LED matrix graphic data has to be switched to word string data sequence and be downloaded to LED matrix controller. The picture of LabVIEW corresponds to that of LED matrix picture and which are presented with the data encoding of binary system signals. The English letter “A” is shown in the 8×8 matrix display and the data switching encoding planning is shown as Fig.12. Therefore, take 8×8 matrix for example, a matrix picture at least needs 64 bits of data string to be saved. And among these, “logic1” presents LED matrix points are on, while “logic0” presents the LED matrix points are off.

In the LabVIEW graphical programming software, upon completion of planning for the LED matrix display picture, the next step required is data switching encoding. In this example, matrix picture page switching dynamic display is set and displayed as “function 1” (fadeout and zoom), and the matrix is shown in the examples in page 1 “P₁,” page 2 “P₂,” and page 3 “P₃.” The encoding format and function definition mentioned above, and the word string data sequence is shown in TABLE 2. This data sequence is transmitted to LED matrix controller and the display will show the values set.

The development board of education used in this study is made by I-Chung Computer Co., Ltd. It can be displayed as LED matrix, function as a serial transmission interface, perform data connection with computers, and is suitable for teaching purposes.

Fig.13 shows the connecting computer and development board of education for practical experiments. Fig.14 shows the operating picture of a webcam monitoring system.



(a) 8x8 MATRIX SHOWING “A”

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte0	0	0	0	0	0	0	0	0
Byte1	0	0	0	1	1	0	0	0
Byte2	0	0	1	0	0	1	0	0
Byte3	0	1	0	0	0	0	1	0
Byte4	0	1	1	1	1	1	1	0
Byte5	0	1	0	0	0	0	1	0
Byte6	0	1	0	0	0	0	1	0
Byte7	0	0	0	0	0	0	0	0

(b) DATA SWITCHING ENCODING
Fig.12 Plan for Data Switching Encoding

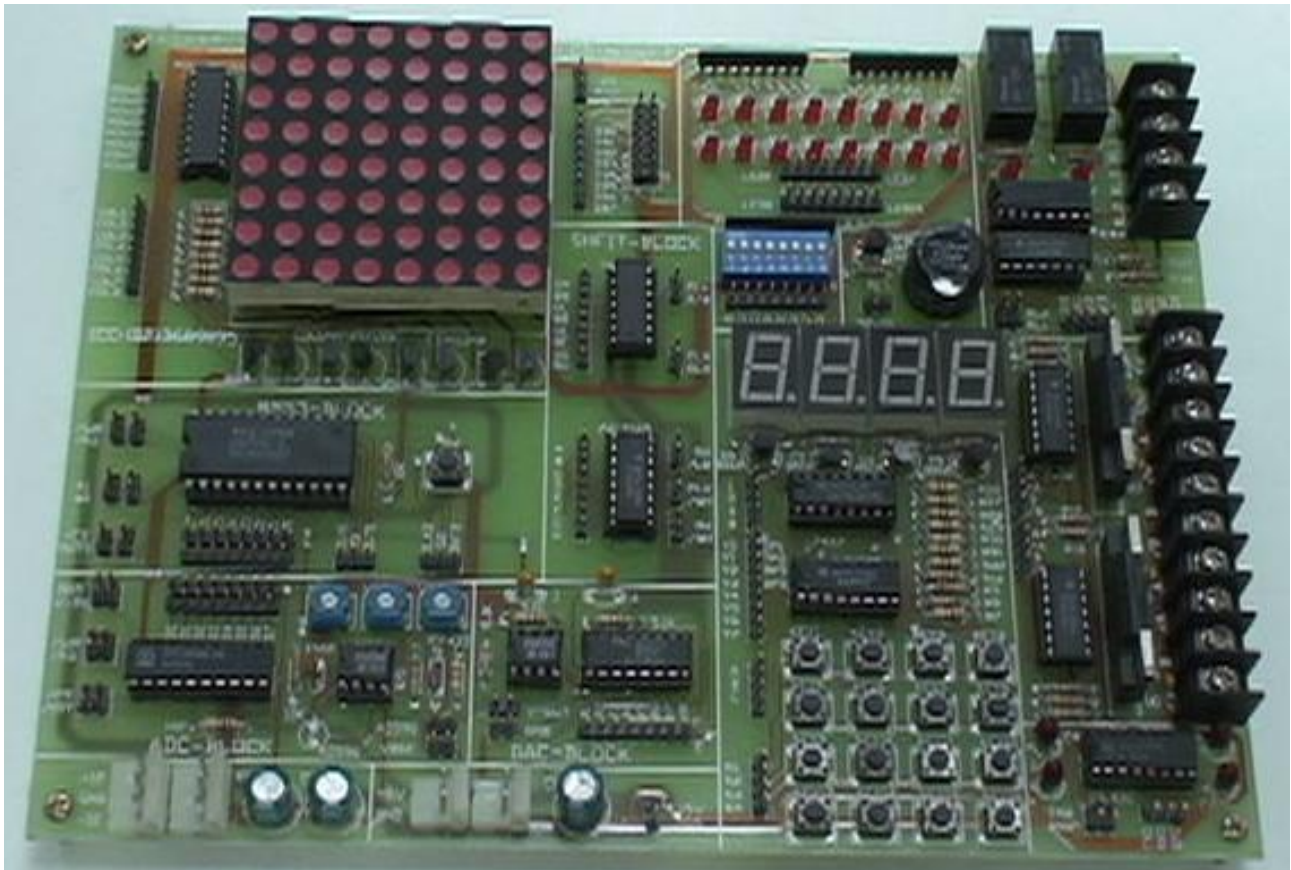


Fig.13 REAL OBJECT GRAPH OF THE DEVELOPMENT BOARD

Table 2 Definition of Function Switching and Data Sequence

Definition of function	Sequence of data string	Binary system (Bin)	Hexa-decimal (Hex)
Show switches "function 1"	1	11110001	F1
Page 1 Show data on picture: "P ₁ "	2	01110000	70
	3	01001000	48
	4	01110000	70
	5	01000100	44
	6	01001100	4C
	7	01000100	44
	8	01000100	44
	9	00001110	0E
Page 2 Show data on picture: "P ₂ "	10	01110000	70
	11	01001000	48

Definition of function	Sequence of data string	Binary system (Bin)	Hexa-decimal (Hex)
Page 2 Show data on picture: "P ₂ "	12	01110000	70
	13	01000100	44
	14	01001010	4B
	15	01000100	44
	16	01001000	48
	17	00001110	0E
Page 3 Show data on picture: "P ₃ "	18	01110000	70
	19	01001000	48
	20	01110000	70
	21	01001110	4E
	22	01000010	42
	23	01001110	4E
	24	01000010	42
	25	00001110	0E

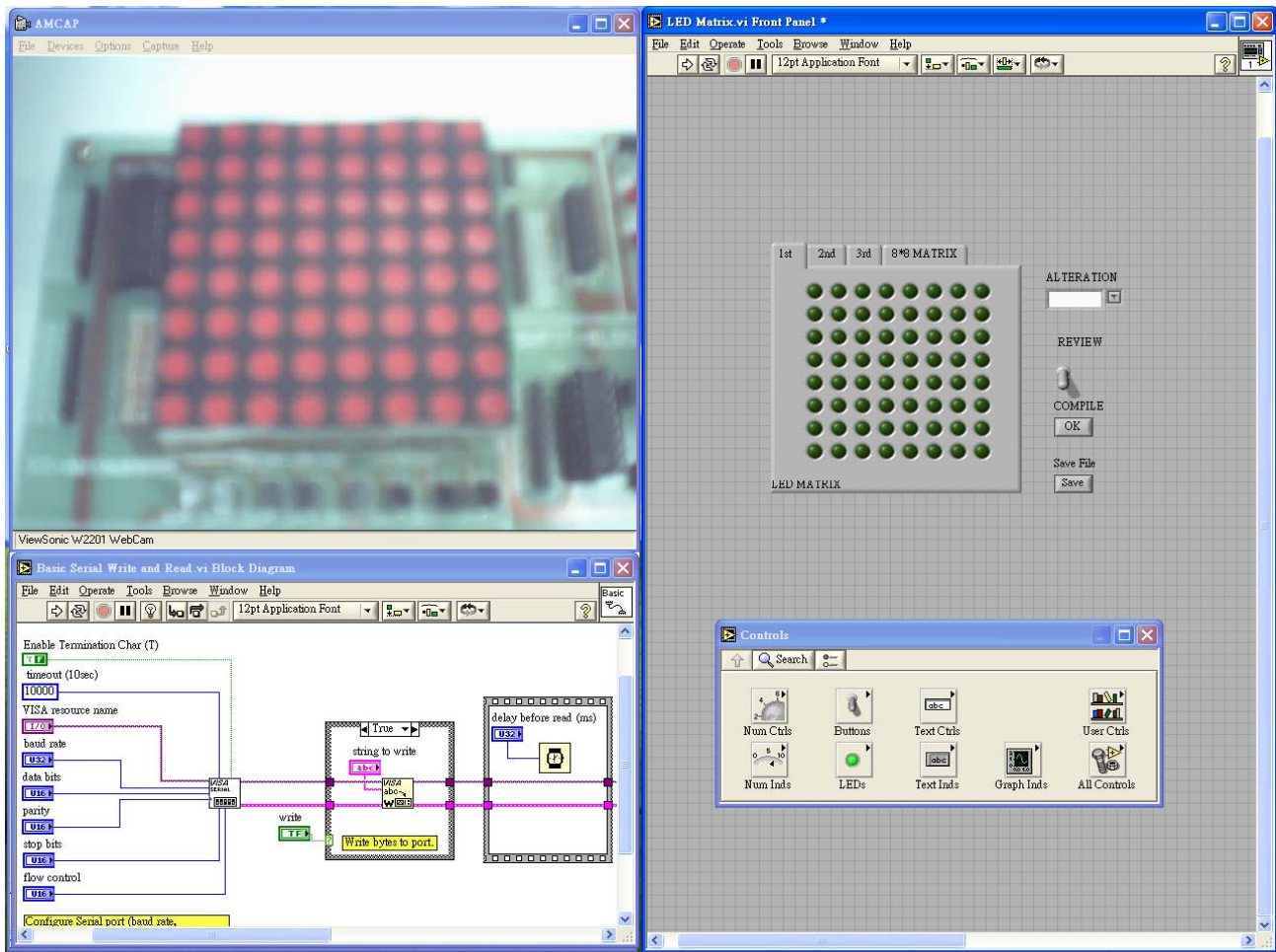


Fig.14 Operating Picture of the Webcam Monitoring System

4 Conclusion

In this teaching example, the remote desktop control of the Windows operating system is used to connect with the computer in the laboratory and LabVIEW graphical programming software is used to write LED matrix character string data and display picture. Students use LabVIEW high level programming language to edit and interpret word string and data sequence, and then download the results to the development board of education. A single chip microprocessor reads the sequenced data and then the LED matrix scan control program is written by students.

Finally, the webcam monitoring system tests the program to see whether or not it executes as expected. Students will learn to use the integrated control technique of the software through practical training. They will also learn to control the word string data interface switch. Other than that, practical training with the development board of education enables students to learn design techniques for encoding and decoding data sequence, operating principle of LED matrix array scanning, to

know how to write programs with high and low level programming languages, and also to learn the control technology for firmware integration.

Through the “LabVIEW system integration practical training” drawn up in this study, students can familiarize with the high level programming language, human machine interface, and microprocessor-based development board of education. They will also learn how to operate word string data sequence and the application of related firmware technology. After learning to operate human machine interface and multi-system integration, students’ professional knowledge and design techniques can be improved for project executing and practicing.

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