Remote Control Framework

By Simon Hui

Technology

The Remote Control Framework is based on the technology called the Virtual Network Computing. The VNC is developed by a research group of AT&T. It uses the remote frame buffer concept to access the graphic user interface GUI of a remote server. Hence any changes in the computer screen of the server will be reflected in the local computer. When client at the local computer presses a key or clicks or moves the mouse, the same actions will be done on the remote computer. A block diagram that outlines the connection is shown in Fig. 1.

![Block Diagram of the Remote Control Framework](image)

The local computer is installed with a VNC Client, or so called the VNC Viewer as it is a thin client of only hundred kilobytes or so. Through VNC protocol, the VNC Server and VNC Viewer exchange information with one another. The remote server is also a computer that connects to equipment concern. Application programs are also running in the computer. The applications are deployed to control the operation and to monitor the status of the equipment. Hence, if a local computer at the client side and a remote server is connected through VNC protocol, user at the client side can access the equipment at a long distance. Hence whatever application programs are running on the server, as long as the graphic user interface or GUI of the remote server is showing the status of the equipment and is connected to the machine, the user is able to control it.

Since the GUI of an application program itself is already a good feedback of the status of the application and the equipment. Hence the local user knows the conditions or states of the equipment immediately. The local client can input commands through the GUI that is already an ideal interface to control the remote equipment. There is no need to write another interface software for the tele-operation, it save a lot of time. Also there is no need to install the application program on the local computer that may be desirable.

Installation

The VNC Server and VNC Viewer can be downloaded together from the VNC website ([http://www.uk.research.att.com/vnc/index.html](http://www.uk.research.att.com/vnc/index.html)) in zip format of less than 1 M byte. In this Chapter, windows32 operating system is assumed. After unzip of the file, run the WinVNC setup program. After installation, the WinVNC should be configured and a password should be entered as shown in the Fig. 2.
As the VNC system uses TCP/IP socket connection, the client must specify a display number in order to view the server. Hence the WinVNC must also have the display number specified. The display number is 0 by default if Auto is selected.

![Configuration of WinVNC](image)

Fig. 2 Configuration of WinVNC

As the WinWNC is installed, the VNC Viewer is also installed. The VNC Viewer can be executed. Assuming a remote VNC Server is running and the local client user knows its IP address, the user can execute a VNC Viewer and input the IP address of the remote VNC Server. Since the remote VNC Server already has its password setup, through simple challenge and response procedure, the Viewer can log in to the Server. The display number should also be entered after the IP address, for example, if the IP address is 158.132.153.178 and the display number is 0, then the address of the server will be 158.132.153.178:0. The authentication procedure follows with a session password as shown in Fig. 3.

![Authentication Procedure](image)

Fig. 3 Authentication Procedure
A local client can also view the remote server without installing VNC System, however, a browser such as Microsoft Internet Explorer or Netscape Communicator must be used. When a server is access by an Internet browser, a Java applet functioned as a VNC Viewer is embedded in a returned web page. The local user can input the URL in the form “http://IP_address:5800+display number” for example, if the IP address is 158.132.153.237 and the display number is 0 then the URL becomes http://158.132.153.237:5800 as shown in Fig. 4.

![Connected to VNC Server Through Internet Browser](image)

**Fig. 4** Connected to VNC Server Through Internet Browser

**Video Feedback**

To facilitate a VNC session, some auxiliary means of communication may be necessary for example, through video feedback; the user can monitor the status of the equipment. A VNC Server is executed in a computer that controls the lens of a video camera. As a result user can access the control of the camera through a VNC system.

To show schematically, the connections with the equipment and the camera are shown in Fig. 5.
The use of remote camera control is an effective mean to monitor the operating condition of the equipment. Similar to set up VNC Server previously described, a camera control application software has also been executed. A control cable is also connected between the camera controller and the computer. The control application software is a kind of window program. It uses serial communication protocol to control the camera. The VNC system is setup and allows client at a distance to control the lens of the camera.

(Rewrite after reading the Chinese script)
As shown in this figure, a remote VNC server is also operating a camera control process. Video camera is controlled by the server through a camera controller. The major functions of the camera controller is to transform commands from the server to analog signals to control the actions of the camera. Through the VNC Viewer, client can control the camera that is connected to the server.

An example is shown in Fig. 6, after the user enters the password, the GUI is shown to the user. On the left of the screen, the video capturing by the camera is shown. At the middle of the screen, a picture is opened as a window in the GUI to prompt for any preset angle for the camera. On the right of the screen, a window showing the camera control user interface that will enable the local client to control the camera lens such as pan, tilt and zoom. As the user click a button at the camera control interface window, the camera lens will adjust and the view is shown on the preview window on the left.
Based on the control framework, many training activities can be arranged. Three categories of training modes can be arranged, namely one-to-one training, one-to-many training and relay training.

**One-to-one Training**

In this one-to-one training mode, the role of the teacher and the learners can be changed, in this slide, the tele-operation right can be granted by the teacher to the learners. Since the teacher is in the Server side, he or she has the right either granting or not granting the control rights of the learner. In this case, the teacher can supervise the learners to perform some tele-operations. As the GUI of the teacher’s computer and the learner’s computer are the same, the teacher immediately knows what the learner is doing on the equipment.

In other cases, the teacher is at local client and the learner is at the remote machine. For example, a supplier of some machine and its customer has just brought a machine. The supplier may through the local client access the remote machine. The customer can observe what the supplier demonstrates. In fact machine manufacturers can use the remote control framework to troubleshoot remote equipment.

**One-to-many Training**
When there is more than one group of students are viewing the demonstration at different places, teacher can add new clients at will. The demonstration will be synchronous to all viewers as shown in Fig. 7.

![Fig. 7 One-to-many Training](image)

**Relay Training**

Relay training is more sophisticated as shown in Fig. 8. In this case, the teacher is at a local client and the machine is at the remote server. Of course the teacher can access the computer, however the students is not at the remote server but at other places. For example, if a supplier sold a machine to an organization, there is another prospective customer who is interested in the machine but want to see a demonstration. If the organization is willing to share its machine then the supplier many have both VNC Client and VNC Server installed in same computer. The supplier then connects the remote machine, and add a client, then the supplier can demonstrate to the prospective customer.
Conclusion

The remote control framework is based on the VNC System that allows users to access a remote equipment at a distance. Through the framework, a lot of learning and training activities can be arranged. It allows demonstrations as well as practicing online. This framework will provide direct access of physical equipment instead of static learning content such as multimedia or text based web pages. This framework allows new opportunities of knowledge transfer and collaborations.