A Cisco Education Tool Accessible to the Vision Impaired

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ABSTRACT

This paper describes iNetSim, a universally accessible network simulator, created to allow vision-impaired and sighted users to complete Cisco Certified Network Associate level two (CCNA 2) laboratory sessions. Previously, software used in the CCNA course was not accessible to those with impaired vision because it utilized images of network topology. These images were incompatible with screen reader software. In contrast, iNetSim is assessable by blind and vision impaired users, in addition to those with normal vision. It is based on Mac OS X Tiger, an operating system with an integrated screen reader called VoiceOver.

Categories and Subject Descriptors

H.5.2 **[Information Systems]**: Interaction styles (e.g., commands, menus, forms, direct manipulation), Voice I/O

K.4.2 **[Social Issues]**: Assistive technologies for persons with disabilities

General Terms

Design, Human Factors.

Keywords

Vision-impaired, Screen readers, Universal Access, User interfaces, assistive technologies.

1. INTRODUCTION

In 2004, Curtin University commenced a pilot program to teach vision impaired students industry standard certification courses [1]. Vision-impaired students taking the Cisco Certified Network Associate (CCNA) course have limited access to the traditional learning resources due to the visiocentric nature of the materials. In particular, Packet Tracer (cisco.netacad.net) is a Macromedia Flash application that uses images, not text, to display information. As screen readers do not work with Packet Tracer, only sighted students can use it. To overcome this limitation, the iNetSim application described in this paper was developed to be a "universally accessible" network simulator for use by both sighted and vision-impaired students.

2. DEVELOPMENT ENVIRONMENT

On April 29, 2005, Apple Computer Inc. released Mac OS X Tiger version 10.4. This release included VoiceOver [2], a system wide screen reader designed to provide full computer functionality to vision-impaired users. Mac OS X includes the Cocoa API [3] that allows rapid development of complex applications, and Core

Data [4], which reduces the time required to implement an application's document back-end. As a result of these features, Mac OS X Tiger was chosen as the programming and execution platform for iNetSim.

3. SPECIFICATION

iNetSim is intended to replace Packet Tracer, allowing vision-impaired and sighted students to complete CCNA level 2 (Routers and Routing Basics). For CCNA 2, "students will develop skills on how to configure a router, manage Cisco Internetwork Operating System (IOS) Software, configure routing protocol on routers, and set the access lists to control the access to routers." [5]

All user interface and network topology elements are reachable with VoiceOver keys and provide a meaningful response when read by VoiceOver.

3.1 Topology Design

The system represents network devices including routers, switches, hubs and PCs. Input of device configuration data is required for simulation.

Each device may have several ports of different types including Ethernet, serial and console. The user creates a connection by specifying two ports to connect and a cable type. Removing a connected port disables the connection the same way unplugging a cable would in a real network.

3.2 Network Simulation

A command line interface to devices provides control and feedback over the simulation. The interface acts in a similar way to the operating system for that device type (e.g. a generic DOS-like system for PCs and Cisco IOS for routers). A subset of the commands applicable to CCNA 2 allows the user to display and modify device configuration, establish routing protocols and ping, Traceroute or telnet to other devices. iNetSim maintains a representation of routing tables to simulate these tasks correctly. As an educational tool, iNetSim aims to simulate the results of these tasks as close to the real systems as possible. Extensibility is important, as iNetSim will need to adapt to higher CCNA levels in future.

4. USER INTERFACE DESIGN

Accessibility for the vision impaired drove the design of iNetSim. Network simulators usually depend on the use of a mouse to add simulated communication links between devices. To connect two devices with a communications link, the user must generally click on icons for the simulated devices. As this may be a problem for vision-impaired users, iNetSim also incorporates the use of tables for connecting devices. Tables are used to alter a device's location in the topology area, and configure ports and links. Tables are

used because navigation can be achieved with VoiceOver shortcut keys and cursor keys. iNetSim can be used solely with the keyboard, therefore the eye and hand issues faced by vision-impaired students can be avoided. As a GUI is also available, sighted iNetSim users can alternatively use a more traditional drag-drop mouse-based interface.

Figure 1 shows an example of the user interface in iNetSim. The text in the floating window in the figure shows the text read by VoiceOver.
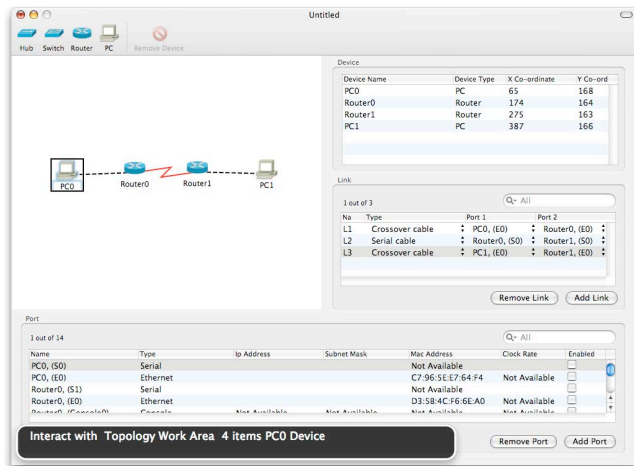

Figure 1: The user interface showing interaction with VoiceOver

4.1 VERIFICATION

A totally blind user took part in a beta test of iNetSim. The user successful completed the two CCNA 2 laboratories in the test, even though he was unfamiliar with the material in those modules. During a post-test interview, the subject indicated that he was impressed with iNetSim's ease of use.

Tools capable of discovering accessibility problems are available for use by application designers. However, usability issues for specific disabled users are still difficult to assess because available tools fail to consider usability criteria to particular vision-impaired people [6][7]. Each tool has a varying level of completeness (how many checkpoints from accessibility guidelines are covered), correctness (how well false positives, where the issue identified is irrelevant or wrong, are reduced) and specificity (number of different possible issues detected) [8]. Involving representative users in field testing, prototyping and evaluation will generally lead to better usability[9].

Verification of the final interface using the Accessibility Verifier , revealed few issues. These issues were missing descriptors (AXDescription), and were trivial to fix.

Tests with vision impaired subjects and the results from the available accessibility tools, show that iNetSim is accessible and simple to use, allowing vision-impaired users to complete selected CCNA 2 laboratories.

5. CONCLUSIONS

Assistive design choices made in the early stages of development lead to a better quality product. The constraints imposed by the screen reader required a well-designed graphical user interface. Having a representative user assist with prototyping, development and evaluation provided insight into usability issues for the vision-impaired. iNetSim is a fully accessible network simulator that allows vision-impaired CCNA 2 students to complete network topology laboratory sessions.

6. ACKNOWLEGEMENTS

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