

A Network Device Simulator in Android Platform

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Abstract— Network device simulator software are used by learners of computer network subject to facilitate learning without using the real network device such as routers, switches and cables. This is done by practicing the commands of network device configuration on the simulator. This paper presents a work in progress on the development of a network device simulator application. As opposed to existing network device simulators that are built for desktops, the simulator that is being developed runs on Android-based mobile devices. The application also utilizes sound educational principle to ensure its effectiveness as a learning aid for computer network learners. The outcome of the work is an Android application that simulates a range of network devices. This application will enable the users to practice configuring network devices anytime anywhere using their mobile devices.

Keywords— mobile learning; simulator; Android; engineering education; m-learning

I. INTRODUCTION

The ability to configure network devices such as routers and switches is one of the practical competencies need to be mastered by learners of computer network subject. It forms a big portion of the practical part of the subjects as taught in university level courses or in professional trainings. The configuration works involve selecting the correct devices and connectors and making correct connections between them, and keying in appropriate commands in the devices to fulfil a particular task. To attain mastery, learners must practice the configuration exercises many times, from making the most basic configurations, stepping up to more advanced tasks.

Accordingly, teaching labs are usually equipped with expensive network devices to provide early exposures to learners. However, due to issues such as high cost and limitation of lab usage, the real devices in labs are not always available to be practiced on by all learners at all times. To cater to this problem, network device simulation software are created to enable learners to practice the network device configuration using their personal computers.

A review of network device simulators that are widely available are presented by the authors in a previous work by Khadijah et. al [1]. The software reviewed are all in the form of desktop-based software. As learners nowadays become more dependent on mobile devices for learning, this work is taken up to take advantage of the advancement of mobile technology in education.

II. PREVIOUS WORKS

The previous works presented here are network device simulation tools to aid learning computer network and an Android application that aids learning of programming. The works exist in different platforms and architectures to cater for different needs of the users. However, all the network device simulator tools that have been studied run in desktop computers, as the mobile version is yet to be produced up until this time. These works are reviewed here as they help provide future direction for the work in progress.

A. Network Device Simulators

As concluded in [1], the most widely used and feature-rich network device simulator/emulator are Cisco Packet Tracer [2] and Graphical Network Simulator 3 (GNS3) [3]. Besides this desktop-based software, web-based network device simulators like Networking Exam Academy's simulator [4] and Gambit Communication's MIMIC® Virtual Lab Cloud [5] are also available. Users of these cloud-based simulators require internet connection to run them.

Rietsche et. al [6] presented a research about LinuxZoo, an online virtual learning environment (VLE) for the purpose of learning Cisco Certified Network Associate (CCNA) curriculum. The VLE features a web based interface for users that includes tutorial and router configuration practices. It has a client-server architecture that enables online router emulation facilitated by a Dynamips [7] server that runs router emulation. Although the web front-end enables users to run the VLE without any need for software installation, the thin client architecture causes a high requirement of CPU power and memory size of the server in order to cater multiple users.

The use of Dynamips server to support remote user connection running Cisco devices emulators is also reported by Li et. al [8], [9]; but with a different approach. In this research, the virtual devices are bridged to the real network and users connect to the facilities through telnet sessions.

The network device simulator software studied are summarized in Table 1. As shown in Table 1, all of the works studied feature either desktop software that cannot be run in mobile devices, or client-server based programs that need continuous connection to its server where virtual network devices operating systems are located. The table also gives a comparative view of the different platforms and architectures used to develop network device simulator tools.

TABLE 1. NETWORK DEVICE SIMULATORS

Application	Platform	Architecture
Cisco Packet Tracer [2]	Windows, Linux	Stand-alone or connected to other users
GNS3 [3]	Windows, Linux, Mac	Stand-alone
Networking Exam Academy's simulator [4]	All OS running browsers	Client-server
Gambit Communication's MIMIC® Virtual Lab Cloud [5]	All OS running browsers	Client-server
LinuxZoo [6]	All OS running browsers	Client-server
Li [8], [9]	All OS running telnet	Client-server

B. Android Application

On the other hand, various researches have been conducted on making use of mobile devices to support learning. In a recent research, the use of Android development platform as the approach to practice Java programming has been studied by Tigrek and Obadat [10]. In the research, a Java programming teaching module that can be implemented in Android mobile device has been developed. The module enables engineering students of various knowledge backgrounds to learn Java programming together with Android application programming.

III. LEARNING PRINCIPLES

The mobile simulator is developed to facilitate learning backed by proven educational principle relevant to the nature of learning taking place. Hence, problem-based learning principle [11] is chosen due to the nature of the work that is intended to be used by learners to solve problems on configuring network devices.

IV. DESIGN OF ANDROID-BASED SIMULATOR

The flow of the mobile simulator is depicted in Figure 1.

After a second of splash screen, a menu of practice exercises available is presented to the user. After choosing one of the exercises available, the user is brought to the second screen. In the second screen, the scenario of problem is displayed to be read by the user. By clicking the next button, the user is shown the next screen where the work area is placed. A task is displayed on the top of the screen. The task is one of the step-by-step instructions of the scenario from the exercise that the user has chosen before. In the work area, user is required to place in all the specified devices and connect them with the correct connectors at the correct slot. A message

will be displayed if the task is not carried out correctly. After the working area is placed with all devices and connections as required, user can click on any of the device to be brought to the command configuration screen. In this screen, the user types in command as required to be keyed in to the specific device for the specific scenario.

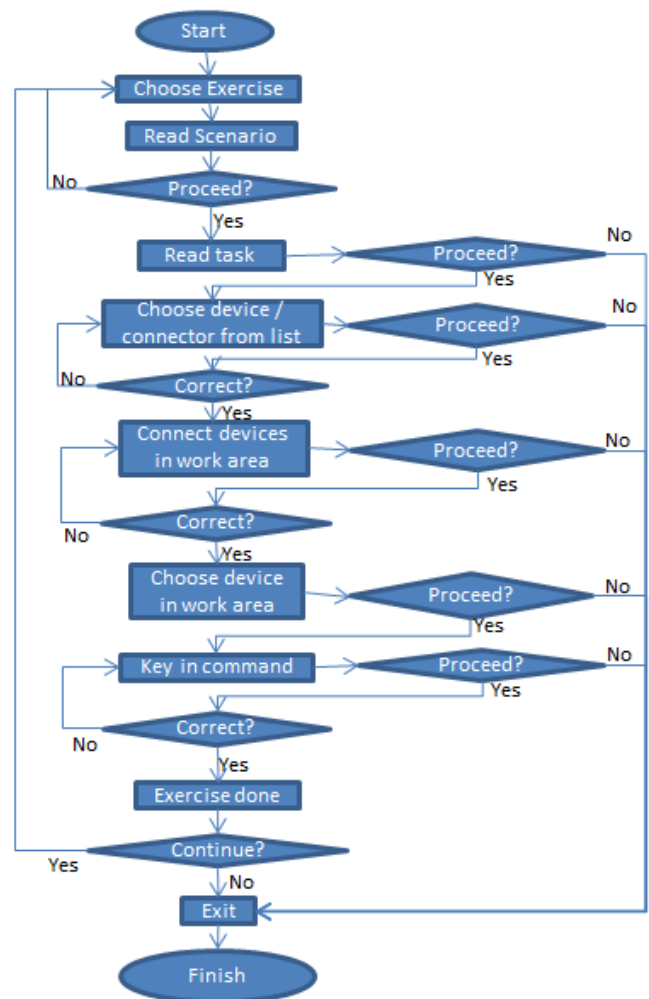


Figure 1. Flowchart of mobile simulator

The whole flows are grouped into the following three modules: - choosing an exercise, virtual lab connection setup and device configuration.

A. Choosing an Exercise

This module allows users to choose an exercise from the list of exercises displayed, as shown in Figure 2.

B. Virtual Lab Connection Setup

Figure 3 shows one of the screens in this lab connection setup stage. The lab connection is set up by choosing the correct device as specified in the instruction and putting the right connector between them. The user's input is checked and response is given. If the user chooses a wrong device or connection, user is asked to change to the correct one until a

correct choice is made. After correct devices and connections are placed in the work area, user clicks on the device symbol on the work area to configure them.

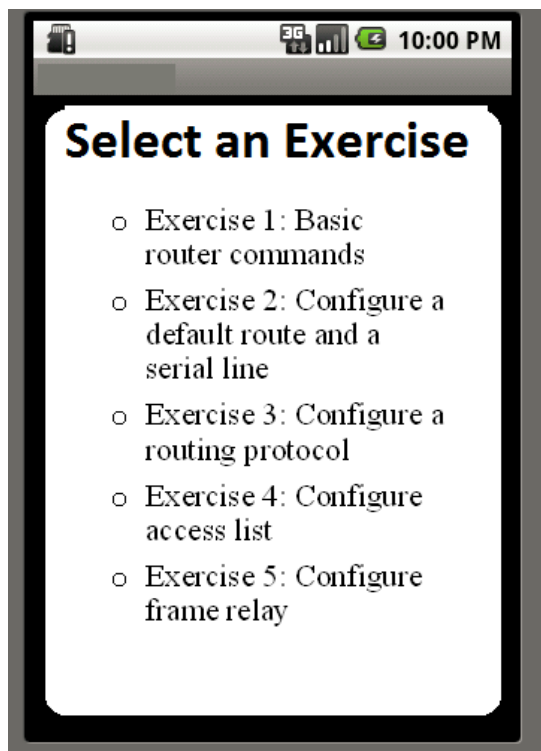


Figure 2. Selecting an exercise

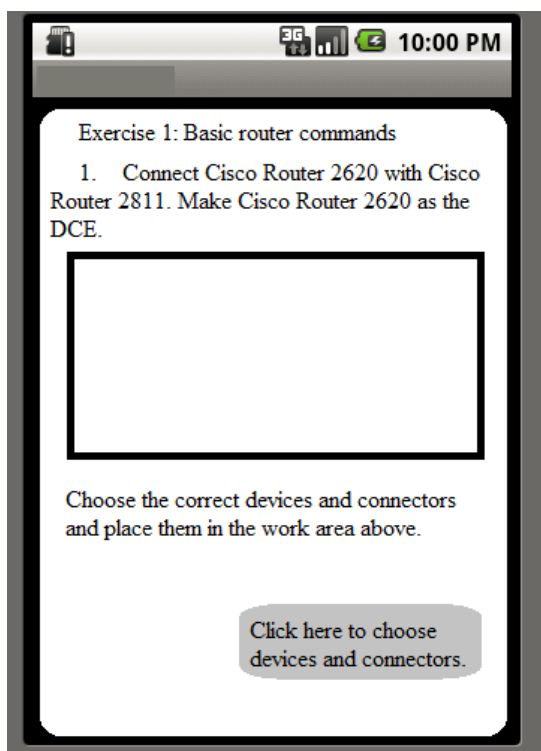


Figure 3. List of devices and connections

C. Device Configuration

In this module, a terminal window is displayed for each device where the user types in configuration command. The terminal window simulates the real device terminal window where messages are displayed, command prompts are provided and error messages are displayed when the user keys in wrong commands.

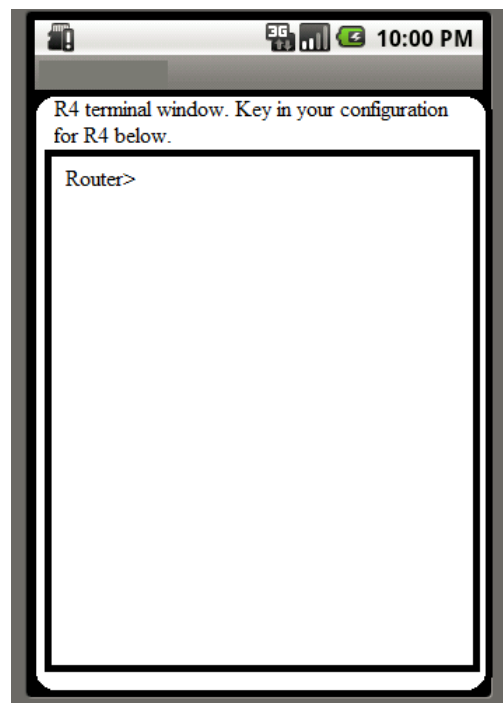


Figure 4. Terminal window for the selected device

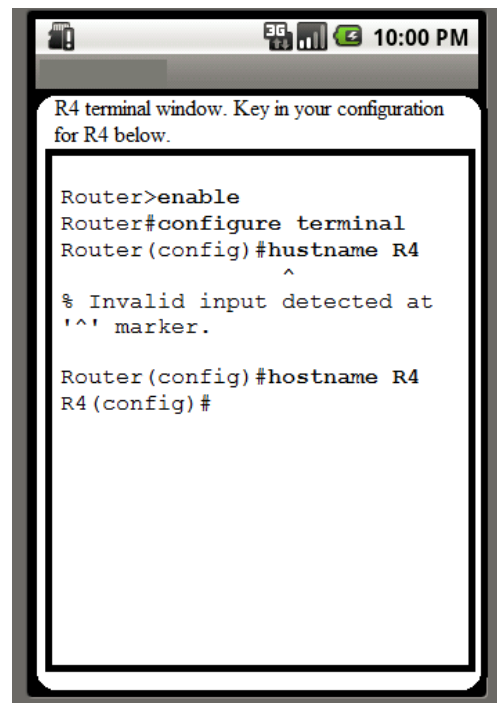


Figure 5. Error message is displayed if user keys in wrong command

V. LIMITATIONS OF THE FINDINGS OF THE STUDY

The work explores how an Android based mobile learning tool helps learning network device configuration based on the principles of problem-based learning. It particularly focuses on learning text command based configuration rather than configuration that can be done using graphical windows. The work also focuses on developing the learning tool based on problem based learning principles which requires exercises and problem solving rather than transfer of learning contents.

VI. CONCLUSIONS AND FUTURE WORK

The work in progress is expected to be able to fill gaps existing in the state-of-the-art research in mobile learning for learning network configurations. This work will be expanded to include modules that fully integrate the problem-based learning principles for learners of computer network subjects.

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