Available online at http://scik.org

J. Math. Comput. Sci. 10 (2020), No. 6, 2907-2916

https://doi.org/10.28919/jmcs/5018

ISSN: 1927-5307

WEB-BASED NETWORK DESIGN LEARNING SYSTEM

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Abstract: Web-based learning system offer a better learning environment for computer science students. This paper presents a web-based learning system that helps students understand the essential knowledge about networking design. The aim of the web-based learning system is to simplify the process of network designing by using a user-friendly interface.

Keywords: web-based learning system; network; networks design.

2010 AMS Subject Classification: 97U50.

1. INTRODUCTION

A large number of computer desktop and web applications are being developed. They maximize the learner's experience by making it more efficient, flexible, and therefore enjoyable. They provide an excellent opportunity to apply and test the management skills the students learned in classrooms, but never had a chance to implement in reality.

Web-based learning systems are a form of computer-based instruction that uses the Internet to transfer of knowledge, skills, and to carry out various learning activities [1-6]. It could be fully

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Received September 12, 2020

online learning or blended in which the instructor meets students as both face-to-face and online. Web-based learning systems could be integrated into a curriculum as a full course or as a supplement to face-to-face courses, depending on the requirement and needs of the curriculum. The main advantages of web-based learning systems are the time, the place, and the pace at which student can learn [7-12].

A wide of range of Network Design programs are available in the market. However, they vary in cost as well as in quality of the presented information. Network design refers to the process of planning a computer network infrastructure implementation [13-17].

Designing, maintaining, and supporting an efficient Information Technology (IT) infrastructure can be a daunting task for any company, especially for a corporation such as Airlines with hubs, facilities, offices, and personnel scattered across the globe. That's why Airlines and all corporations are working hard to optimize its IT design processes across the enterprise.

Network designing is a very important step before setting up any kind of efficient network. The designing phase will give us the possibility to set a network with optimum design requirement by using very few devices, which reduces cost and optimizes performance.

Currently many vendors are providing specialized software in network design. Packet Tracer by Cisco and 'NetSim' by Boson are some of the most used softwares. 'NetSim' is considered one of the simplest software from a functionality and a flexibility point of views.

Cisco Packet Tracer is a network simulator software that allows users to simulate the configuration of Cisco devices using a simulated command line interface. This software teaches how networks can be configured. It gives a real time experience like other simulating devices. Packet Tracer is ideal for the CCENT and the CCNA Routing & Switching certificates. One of the disadvantages of Cisco Packet Tracer is that it doesn't support non-Cisco devices. Boson NetSim also has some disadvantages, such as absence of topology information and customization, and an inability to modify active topology.

In the next section we will describe the Web-Based Network Designer. Section 3 describes the system data design and implementation. Section 4 describes the system features and user

interface. Section 5 evaluates the tool and reports results of the user acceptability tests. Finally, the conclusion.

2. THE WEB-BASED NETWORK DESIGNER

The Web-Based Network Designer is a tool that satisfies any network designs needs, complexity and range (LAN, WAN, etc.), it can be used as a reference to any network in case a design change is needed in the future or for maintenance issues.

The Web-Based Network Designer can be used for educational purposes:

- Instructors can use the Web-Based Network Designer as a visual tool to help students in the network design process or by providing a clear vision about network topologies and components.
- Students can interact with real network components and gain essential knowledge about networks. In addition, they will be able to familiarize themselves with network objects.

The main goals of the Web-Based Network Designer are to allow users to build/design a network by many functions as listed below:

- The ability to select and drag and drop the device from listed devices into drawing panel.
- The ability to connect the devices with each other by selecting tow devices and choose the cable type.
- The ability to move any devices anywhere in the panel at any place with all connection at that device.
- The ability to store any action by the user to the database.
- The ability to design many layers (sub networks) in one network, which mean we can design a network inside network in-side network, etc.
- The ability to keep controlling layers if the network consists of many layers, by providing a guide which will help users to navigate their layers in the network.
- The ability to use any network or layer as a layer into another network.

A huge network can be designed by using a software like Cisco Packet Tracer r or Boson NetSim,

by design each part or sub network separately (i.e. many files needed). Moreover, in the worst case we can use Adobe Photoshop to draw the network, but this process takes a lot of time and effort (if we ignore the efficiency part). But by using the Web-Based Network Designer we can design any network with the ability to control at all sub networks belonging to the network. Moreover, it has the ability to use any network or part of a network as a sub network into another network.

The Web-Based Network Designer has a database which stores any user action such as, the coordinates of any device, the type of the device, and the connections at any device, so any network will be stored in the database with all its devices and connections, this mean we can retrieve any network at any time. So if any network is stored in the database we can design a network inside a network (layers) by storing each layer as a network (each layer is a network and each network is a layer). Second, by storing each layer as a network, any network can use any layer or network as a layer in it. Finally, the Web-Based Network Designer interface has a layer navigator which will help users to navigate through layers.

The Web-Based Network Designer has a database which stores any user action such as, the coordinates of any device, the type of the device, and the connections at any device. As a result, any network will be stored in the database with all its devices and connections, which means that they can be retrieved at any time. So if any network is stored in the database we can design a network inside a network (layers) by storing each layer as a network (each layer is a network and each network is a layer). Second, by storing each layer as a network, any network can use any layer or network as a layer in it. Finally, the Web-Based Network Designer interface has a layer navigator which will help users navigate through layers.

3. SYSTEM DATA DESIGN AND IMPLEMENTATION

The Web-Based Network Designer database tables schemas consists of:

- Networks Table (NetID, NetworkName, NetworkBGImage, NetworkDesc)
- Layers Table (LayerID, NetID, LayerName, LanID)

- Switches Table (SwitchID, NetID, SwtName, SwtType, SwtPorts, SwtporConn, SwtX, SwtY, SwtConEth, SwtConSer, SwtConWi)
- Routers Table (RouterID, NetID, Rou.Name, Rou.Type, Rou.Ports, RouporConn, Rou.X, Rou.Y, RouConEth, RouConSer, RouConWi)
- Clients Table (ClientID, NetID, CliName, CliType, CliPorts, CliporConn, CliIP, CliSebne, CliGate, CliX, CliY, CliConEth, CliConSer, CliPortWi)
- Servers Table (ServerID, NetID, Ser.Name, Ser.Type, SerPorts, SerporConn, SerIP, SerSebne, SerGate, SerX, SerY, SerConEth, SerConSer, SerPortWi)
- Connections Table (ConnectionID, NetID, ConnType, ConnColor, ConnX1, ConnX2, ConnY1, ConnY2, ConnFromID, ConnToID, ConnFromIDPort, ConTOIDPort)
- Miscellaneous Table (MiscID, NetID, MiscName, MiscType, MiscPorts, MiscporConn, MiscIPIN, MiscIPout, MiscX, MiscY, MiscConEth, MiscConnSe, MiscConnWi, MiscOth)

Fig. 1 shows the Web-Based Network Designer database class diagram.

Fig. 1 The Web-Based Network Designer database class diagram

The Web-Based Network Designer that we developed assists IT students in learning the computer networks courses. The Web-Based Network Designer was implemented using HTML5,

CSS, and JavaScript for the front-end development, the PHP and MySQL for the back-end development.

4. FEATURES AND USER INTERFACE

The Web-Based Network Designer features:

- A friendly yet powerful web based Graphical User Interface (GUI) equipped with menus and toolbars containing most common network objects, these objects providing the user with the basic elements to build a network. The main network objects are: Connection Types, Switches, Routers, Servers, and Clients, also Miscellaneous Objects such as (Printer, Firewall, Wireless Access Points, etc.).
- The network objects panel includes objects categorized by functionality.
- The Drawing Panel is a wide space area in which the user can insert objects from the network objects panel. This Drawing Panel will hold the final design of the network.
- Backup and restore database.
- Load and Unload network background image.
- Editing network object labels.
- Delete any device from drawing panel.
- Print network diagram.
- Multi layering feature: One and the most important problem is the size of the network (i.e. if the designers/users want to design a huge network, they can't fit the network diagram into one area due to computers screens, so they have to design every part of a network into separate file which mean less flexibility and more complexity moreover inflexible controlling on these files). The Web-Based Network Designer will store network diagrams into the database as records rather than files. The Web-Based Network Designer can divide the network into multi layers (sub networks), and the ability to control all these layers, for example, in any given company, we found departments such as marketing and accounting, each of these departments uses part of the whole network,

the user can build any department's network in the Web-Based Network Designer separately and then combine it with other parts of the network. Combing these parts will form the final network. So the Web-Based Network Designer will satisfy any network designs needs, complexity, and range.

- Every layer will store into layers' table, also into networks table, to ease the open procedure for this sub network later, this means each layer is a network and each network is a layer, so by storing every layer as a network that mean we can use that layer into another network (i.e. all we need is to design it once then we can use it as many time as needed into any network design).

The interface of the Web-Based Network Designer as shown in Fig. 2 consists of the following parts: the menu bar, tool bar, devices and connections, drawing panel, network layers, and status bar. The menu bar and tool bar provide two different ways of accessing options provided in the system. The user can select and drag and drop the device from listed devices. The drawing panel is the area were the user can build/design a network. The network layers panel will help user to navigate layers in the network (if the network consists of many layers).

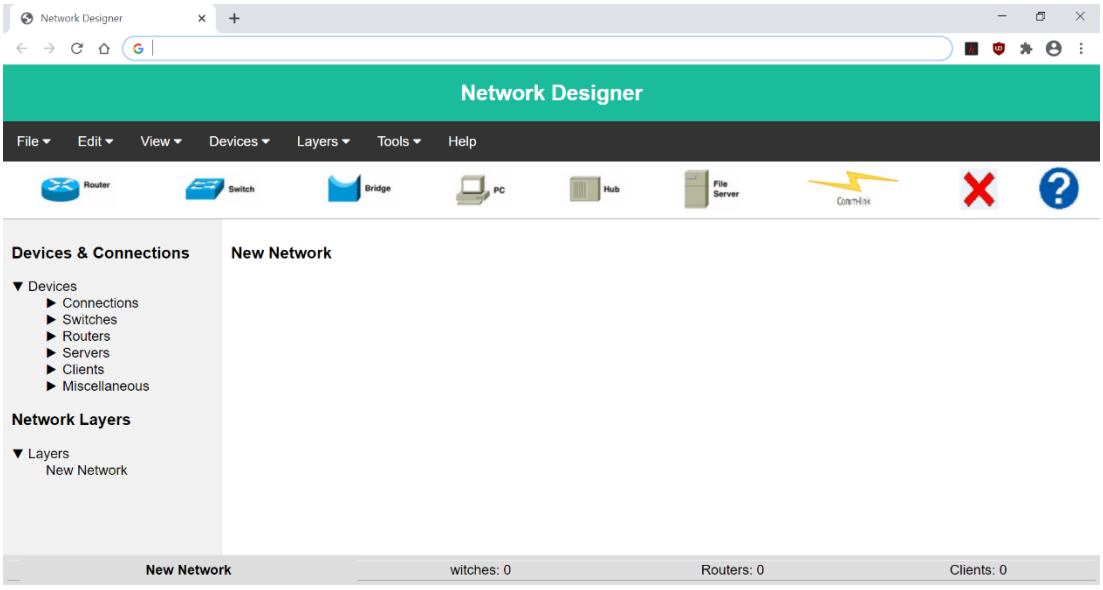

Fig. 2 The graphical user interface of the Web-Based Network Designer

5. EVALUATION

The Web-Based Network Designer will allow students to interact with real network components. As it will provide them with the essential knowledge about networks. Students will be familiar with network objects and what they look like. The Web-Based Network Designer will allow users to drag and drop network devices to the drawing panel, and the ability to move the devices and to connect these devices with each other's with different types of network connection. The Web-Based Network Designer tool will allow the user to store and retrieve a network design at any time to modify or to use it as sub network in another network. A User Acceptance Test (UAT) [18-20] was conducted to evaluate the Web-Based Network Designer by asking the targeted students to fill a questionnaire after using the Web-Based Network Designer. Results showed that 93% of the tested students thought that the tools were easy to use and a very effective way to learn the network design. About 7% of the students thought that the Web-Based Network Designer did not add much to their knowledge.

6. CONCLUSIONS

The Web-Based Network Designer aims to provide a tool that satisfies any network design needs, plus this will become a reference to any network in case a design change is needed in the future. The Web-Based Network Designer is very useful in supporting students to understand computer networks courses. The presented tool has proven its feasibility and usefulness.

The Web-Based Network Designer can assist companies that provide penetration testing services:

- to give approximate knowledge about the architecture of targeted network in blind testing strategy.
- to increase the outcome in targeted testing strategy.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests.

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