The Role of Electronic Learning Technology in Networks Systems

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ABSTRACT

Recently, Electronic Learning Technology (ELT) has been widely spread as one of the new technologies in the world through using Information and Communication Technology (ICT). One of the strategies of ELT is Simulation, for instance Military and Medical simulations that are used to avoid risks and reduce Costs. A wireless communication network refers to any network not physically connected by cables, which enables the desired convenience and mobility for the user. Wireless communication networks have been useful in areas such as commerce, education and defense. According to the nature of a particular application, they can be used in home-based and industrial systems or in commercial and military environments.

Historically, Mobile Ad-hoc Networks (MANET) have primarily been used for tactical military network related applications to improve battlefield communications/survivability. MANET is a collection of wireless nodes that can dynamically be set up anywhere and anytime without using any pre-existing network infrastructure. Mobility in wireless networks basically refers to nodes changing its point of attachment to the network. Also, how the end terminals can move, there are many mobility models described the movement of nodes, many researchers use the Random Waypoint Mobility Model (RWPM). In this paper, a Graphical User Interface (GUI) for RWPM simulation is introduced as a proposal to be used through ELT Project. In the research area of computer and communications networks, simulation is a very useful technique for the behavior of networks.

Keywords: Electronic Learning Technology (ELT), Information and Communication Technology (ICT), Simulation, Mobility, Mobile Ad-hoc Network (MANET), Mobility Models, Random Waypoint Mobility Model (RWPM).

I. INTRODUCTION

Recently, Electronic-Learning Technology (ELT) has been widely spread as one of the new technologies in the world. In Egypt, ELT has been greatly supported in the last few years. To support ELT, the Egyptian government has founded the Egyptian University of E-learning and the Supreme Council of Universities E-Learning project. Nowadays, the variety of different kinds of E-learning systems is very large. There are systems which support individual learning, collaborative learning, learning content management, learning activity management, formal learning, informal learning, and workplace learning. E-learning is the delivery and management of teaching, training and learning by electronic means. E-Learning describes the ability to electronically transfer, manage, support, and supervise learning and learning materials. E-Learning systems are used in both training and education resulted in their adoption by academia, as well as industry. An important goal of e-learning is that it

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should be equivalent to or better than the learning provided through other delivery modes, such as the traditional face-to-face and classroom-based methods of instruction. A significant benefit of e-learning is that it allows learners’ access to learning material at their convenience without the necessity for a Physical classroom, because learners can learn anywhere so long as there is access to the Internet. E-learning enables the instructor to monitor the learners’ progress continuously\(^1\).

II. E-LEARNING TYPES

According to earlier study\(^2\), there are two types of E-learning: Asynchronous or self-paced, and Synchronous or instructor-led. The degree of interactivity, sophistication and expense is different in each type.

A. Asynchronous E-Learning

Asynchronous e-learning commonly, facilitated by media such as e-mail and discussion boards, supports work relations among learners and with teachers, even when participants cannot be online at the same time. It is thus, a key component of flexible e-learning. In fact, many people take online courses because of their asynchronous nature, combining education with work, family, and other commitments. Asynchronous e-learning makes it possible for learners to log on to an e-learning environment at any time and download documents or send messages and comments to teachers or peers. Students may spend more time refining their contributions, which are generally considered more thoughtful compared to synchronous communication.

B. Synchronous E-Learning

Synchronous e-learning, commonly supported by media such as videoconferencing and chat, has the potential to support e-learners in the development of learning communities. Learners and teachers experience synchronous e-learning as more social and avoid frustration by asking and answering questions in real time. Synchronous sessions help e-learners feel like participants rather than isolates\(^3\).

III. SIMULATION BASED E-LEARNING

Simulation is one of the most powerful tools available to decision-makers responsible for the design and operation of complex processes and systems. It makes possible the study, analysis and evaluation of situations that would not be otherwise possible. In an increasingly competitive world, simulation has become an indispensable problem solving methodology for engineers, designers scientists and managers. One of the real strengths of simulation is the fact that we can simulate systems that are already exist, as well as those that are capable of being brought into existence, i.e. those in the preliminary or planning stage of development. Simulation is the next best thing to observing a real system in operation since it allows us to study the situation even though we are unable to experiment directly with the real system, either because the system does not yet exist or because it is too difficult or expensive to directly manipulate it. Simulation provides cheap insurance and cost effective decision making tool for managers. It allows us to minimize risks by letting us discover the right decisions before we make the wrong ones\(^4\).

Simulation can be defined as follow: The process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behavior of the system and /or evaluating various strategies for the operation of the system. Thus it is critical that the model be designed in such a way that the model behavior mimics the response behavior of the real system to events that take place over time\(^5\). High fidelity simulation has become a popular technique for training teamwork skills in high risk industries such as aviation, health care, and nuclear power production. Simulation is a powerful training tool because it allows the trainer to systematically control the schedule of practice, presentation of feedback, and introduction (or suppression) of environmental distractions within a safe and controlled learning environment. Unfortunately, many
within the training community have begun to use the terms simulation and high fidelity simulation almost synonymously \(^6\).

E-Learning is commonly referred to the intentional use of networked information and communications technology in teaching and learning. A number of other terms are also used to describe this mode of teaching and learning. They include online learning, virtual learning, distributed learning, network and web-based learning \(^7\).

E-Learning and simulation technologies have become an important sector in the new century. Some researchers believe that simulations represent one of the many strategies of e-learning. Fig. 1 describes the core of the relationship between e-Learning and simulation technologies \(^8\).

A. Network Simulation

In the research area of computer and communications networks, simulation is a helpful and useful technique since the behavior of a network can be modeled by calculating the interaction between the different network components (they can be end-host or network entities such as routers, physical links or packets) using mathematical formulas. They can also be modeled by actually or virtually capturing and playing back experimental observations from a real production network. Generally speaking, network simulators try to model the real world networks. The principal idea is that if a system can be modeled, then features of the model can be changed and the corresponding results can be analyzed. As the process of model modification is relatively cheap than the complete real implementation, a wide variety of scenarios can be implemented and analyzed at low cost (relative to making changes to a real network).

B. Network Simulator

A Network Simulator (NS) is a software that predicts the behavior of a computer network. In simulators, the computer network is typically modeled with devices, links, applications, etc. and the performance is analyzed. Typically, users can then customize the simulator to fulfill their specific analysis needs. Network simulators serve a variety of needs. Compared to the cost and time involved in setting up an entire test bed containing multiple networked computers, routers and data links, network simulators are relatively fast and inexpensive. They allow engineers and researchers to test scenarios that might be particularly difficult or expensive to emulate using real hardware. Different types of network simulators can be categorized and explained based on some criteria such as if they are commercial or free, or if they are simple or complex ones.
Currently there are many network simulators that have different features in different aspects. A short list of some of the current network simulators include OPNET, NS-2, NS-3, OMNeT++, REAL, SSFNet, J-Sim and QualNet (9).

In the next part, an example of computer networks E-Learning Based on Interactive Simulation (Kiva Network Simulator) that introduces a set of compact interactive simulations developed for the constructive learning or training of computer networks concepts is presented. Kiva NS application has been developed as an autonomous virtual laboratory and permits the users of the courses about computer networks to carry out experiments about the IP routing, without the necessity of complex and expensive real physical equipment such as routers, switches, hubs, PCs, etc. Fig. 2 illustrates the graphical user interface of the Kiva NS application which has been programmed in Java (10).

![Graphical user interface of the KivaNS application](image)

Fig. (2): Graphical user interface of the KivaNS application

MOBILITY IN WIRELESS NETWORKS

A. Wireless Communication Networks

Wireless communication networks refer to any network not connected by cables, which enables the desired convenience and mobility for the user. Wireless communication networks have been useful in areas such as commerce, education and defense. According to the nature of a particular application, they can be used in home-based and industrial systems or in commercial and military environments (11).
Historically, Mobile Ad-hoc Networks (MANET) have primarily been used for tactical military network related applications to improve battlefield communications/survivability. The dynamic nature of military operations means that military cannot rely on access to a fixed pre-placed communication infrastructure in battlefield\textsuperscript{(12)}. MANET is a collection of two or more devices, nodes or terminals with wireless communications and networking capability that communicate with each other without the aid of any centralized administrator, also the wireless nodes that can dynamically form a network to exchange information without using any existing fixed network infrastructure\textsuperscript{(13)}.

MANET does not use any fixed infrastructure; the topology of the network may change rapidly and unexpectedly. MANETs are useful in many application environments and do not need any infrastructure support. Fig. 3 shows an example of an MANET\textsuperscript{(14)}.

![Fig. (3): mobile ad-hoc network](image)

**B. Mobility Models**

Mobility concept is a human's nature, in the field of computing and communication technologies, to be able to communicate with other persons, access and process information simultaneously while moving has been as long expectation that causes great deal of efforts having been made to turn the fancy into fact. Mobility is the characteristic of an object that can be mobile\textsuperscript{(15)}. Mobility in the wireless networks is very popular nowadays. Many people in the street walk and are using small devices like PDA, laptops or phones to communicate and exchanging data with other people near them\textsuperscript{(16)}. Networks without such centralized infrastructure are called MANETs. There, the impact of mobility is much higher, since everything is moving\textsuperscript{(17)}.
The application of mobility model is of great importance because it describes the movement pattern of mobile users by explaining how their location, velocity and acceleration change with respect to time. It is very much necessary to use the mobility models to follow the movement pattern of targeted real life applications in a realistic way. Every mobility model has different characteristics. Choosing an appropriate mobility model may not be as simple as it first appears. A decent mobility model should attempt to mimic the movements of real mobile nodes. Changes in speed and direction must occur and they must occur in semi-reasonable time slots.

In ad-hoc wireless mobile networks, the mobility models focus on the individual motion behavior between mobility epochs, which are the smallest time periods in a simulation in which a mobile host moves in a constant direction at a constant speed. Many researchers use the random mobility model. It is important to use models for mobility and to have some index or quantitative measure of mobility that is relevant to the performance of the network. Fig.4 provides Classification of Mobility Models.

C. The Random Waypoint Mobility Model (RWPM)

In random-based mobility models, the mobile nodes move randomly and freely without restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes. This kind of model has been used in many simulation studies.

The RWPM was proposed by Johnson and Maltz. The model includes pause times between changes in destination and speed. Firstly, the mobile node chooses a random location and considers it as its destination and then it moves towards its destination with constant velocity, which is uniformly

![Fig. (4): Classification of Mobility Models](image-url)
distributed between (minvelocity, maxvelocity). After arriving at the destination, the MN pauses for a specific time before choosing another random destination. The pause time can have the value zero '0', which means that it will continue its movement without any pause \cite{18}. Fig. 5 shows an example for traveling pattern of n mobile nodes using the Random Waypoint Mobility Model starting at a randomly chosen point. Many authors have adopted this model in their simulation studies \cite{19}.

![Traveling pattern of an mobile node using the RWPM](image1)

**Fig. (5):** Traveling pattern of an mobile node using the RWPM

In the next part we introduce a proposal about GUI for RWPM simulation which has been programmed in Matlab \cite{25}. Fig. 6 illustrates the graphical user interface of the RWPM through Electronic Learning Technology Project.

![Graphical user interface of the RWPM through ELT Project](image2)

**Fig. (6):** Graphical user interface of the RWPM through ELT Project
The Random Waypoint Mobility Model is used in many prominent simulation studies of ad-hoc network protocols. It is flexible, and it appears to create realistic mobility patterns for the way people might move in. Generally, mobility models usually describe the movement pattern of nodes and how their speeds and directions are altered over the time. The RWPM is simple and is widely used to evaluate the performance of MANETs.

IV. CONCLUSION

In this new century, ELT is becoming a very important technology. ELT is simply all interactive services that are used through ICT multimedia technologies. One of the strategies of ELT is simulation. ELT and simulation technique can play a vital role in many important sectors. Although benefits are not unique to military learning environments, they are particularly pertinent to the training of military leadership. ELT using simulation is a very important modern technology. It can be applied to different science, engineering, or other application fields for different purposes. Computer assisted simulation can model hypothetical and real-life objects or activities on a computer so that, it can be studied to see how the system function. Different variables can be used to predict the behaviour of the system. Application of simulation technology into networking area such as network traffic simulation or network mobility simulation is relatively new. Mobility is a prominent characteristic of MANETs, there are many mobility models. The RWPM is the model most commonly used in many studies due to its simplicity and flexibility. It is noted that every mobility model may have various properties and exhibit different mobility characteristics. In general, ELT is a proper technique for training or learning, for example wireless communication networks field. We observe that simulation is playing two pivotal roles in our study. First, simulation is one of the strategies of ELT. Second, simulation is very important technique for network simulation to study and analysis the behaviour of network.

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