Netlab: Mobile Learning Application for Data Communication and Networking

by

Mohamad Ashraf bin Mohd Nissfu

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A project dissertation submitted to the

Computer & Information Sciences Department

Universiti Teknologi PETRONAS

in partial fulfilment of the requirements for the

Bachelor of Technology (Hons)

(Information and Communication Technology)

Universiti Teknologi PETRONAS
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CERTIFICATION OF APPROVAL

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Approved by,

_____

Madam Nazleeni Samiha Binti Haron @ Baharon

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

January 2013

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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Mohamad Ashraf bin Mohd Nissfu

ACKNOWLEDGEMENT

ABSTRACT

This report discusses the research done on the chosen topic, which is Development of Mobile Application for Learning Data Communication and Networking (DCN). Basically, this project is about the implementation of M-learning as the complementary platform of learning DCN. The objective of this project is to conduct investigation on the acceptance of M-learning in the process of learning DCN and to study the suitable mobile learning theories for DCN. In addition, this research will also be used to study the effectiveness and user acceptance of M-learning for DCN. Currently, most of the students are unable to grasp the basic concept of DCN as it is a tough subject. Besides, current learning process are also lacking in term of facilitating the students in practical approach, time and place constraint, and also cause student to focus more on memorizing the theory rather than understanding how DCN actually works in real life. This study focus on students of DCN as the main subject, and Android operating system was chosen as the main platform for the application development. The main content of the application consist of simulation, games, and interactive exercises. Specific methodology was built for research purpose, while the Rapid Application Development (RAD) is use for the application development process. Results were obtained from the preliminary investigation that shows the positive subjects' acceptance for the project and also the framework of the study which is based on Activity theory. Test subject (students) also gives positive feedbacks on the application usefulness in learning DCN based on the usability and user acceptance test done.

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ABBREVIATIONS AND NOMENCLATURES

ICT   Information and Communication Technology

DCN   Data Communication and Networking

PC   Personal Computer

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Data Communication and Networking (DCN) is a subject which compose of data communication and network as it main framework. Data communication is the exchange of data between two devices via some form of transmission medium such as a wire cable. On the other hand, a network is a set of devices (often referred as nodes) connected by communication links. The basics components of DCN are crucial in its learning process, which compose of data communications components, data representation, and data flow. Then students will proceed to learn about the structures that carry data, network topologies, categories of networks and et cetera. DCN also compose of the learning of protocols and standards in data communication and networking and also networking models such as Open Systems Interconnection (OSI) and the internet protocol suite (TCP/IP).

Mobile learning (M-learning) is the revolutionary of the conventional way of learning. Most of people found M-learning as the subset of E-learning, but it actually not only that. M-learning is actually the improvements of E-learning as it actually complements the weakness of E-learning. In simple words, M-learning is the ability to obtain or provide any educational content on mobile devices such as smartphones, personal digital assistant (PDA), and tablets.

Currently the main method in learning and teaching DCN is through lectures and practical learning in computer network labs. The current learning method actually covers the important part in the learning process, but many people questioned the effectiveness of this way of learning in order to ensure satisfying student level of understanding. As DCN is actually a tough subject to be learned and taught, many people have actually realized that it is easier to learn DCN through practical approach rather than just theoretically. But there are many things need to be considered when teaching DCN through practical way as it has many constraints such as scarce resource available and mobility of the learning process itself.

1.2 Problem Statement

The problem statements for this project are divided and focused into two, which are:

1.2.1   The problem regarding the subject (DCN)

DCN is actually a tough subject, yet a strong foundation of understanding about this subject is critically important. In addition, most of the students are unable to grasp the basic concept of DCN, and consequently makes the further learning process become much tougher. Besides, practical approach in learning DCN is critically important but learning through practical way requires extensive resources thus make it harder to be implemented efficiently. Moreover, the learning process of DCN requires one to spend their time in labs for practical understanding about the subject as the devices and peripherals used are not easily available elsewhere.

1.2.2   The problem regarding current learning process

Current learning process focuses more on theoretical approach, but it is not enough in ensuring great level of understanding for students. Furthermore, students learn more about 'what' and not 'how' in class where students are usually just memorizing what is needed for examinations or test rather than understand how the subject works and implemented in real life. In addition, lectures in class are usually dominate by lecturer, thus less interaction and response from students were received. Because of this, students tendency to become passive in class are increasing from time to time. Besides that, students are also tied to schedule and place (time and geographical constraint). This is because the lecture was done in class and practical training was done in the computer network lab. Hence students are unable to learn about DCN efficiently if they are not in the lecture or lab sessions.

The teaching and learning process of DCN need to be improved in order to enhance the understanding of the students and also to assist them in the learning process. Issues such as resource constraint, time and space limitation, and other problems need to be catered for the learning process of DCN to be improved. Thus, another platform of learning DCN need to be developed in order to complement the current learning process.

1.3 Objectives and Scope of Study

The objectives and scopes of the studies are outlined as follows:

1.3.1   Objectives

- To conduct preliminary investigation on the acceptance of mobile learning in the process of learning DCN

- To study the suitable mobile learning theories for DCN

- To design and develop a mobile learning application for DCN's learning process

- To run feasibility and acceptance test in investigating the effectiveness of mobile learning in the process of learning DCN.

1.3.2   Scope of study

- Main subject of study

  - Students of DCN

- Specific subject for the study

  - Data Communication and Networking

- Main content of the application

  - Simulation

  - Games

  - Interactive exercises

- Platform of development

  - Using Android OS as the main platform.

The subject of the study is the students and lecturers of DCN, as they are the main character that was affected by this project. The main content of the application and the platform for the development of this project will be discussed further in the literature review section.

1.4 Project Feasibilities

The feasibility studies were done based on four components, which are technical feasibilities, economical feasibilities, operational feasibilities and also the schedule feasibility.

1.4.1   Technical feasibilities

In this project, the technical skills and knowledge in term of programming and networking are crucial as it is the fundamental requirement for the development of the product. Hence able to utilize all the skills needed in order to complete this project.

1.4.2   Economical feasibilities

For this project, no extra hardware needed as all required devices are already available. The software is also available for free for the normal user. Thus no extra cost needed for the development of the product.

1.4.3   Operational feasibilities

Based from the preliminary investigation, this project able to satisfy the objectives identified earlier and also takes full advantage of the opportunity in research process. Consequently this project will benefit the lecturer and students of DCN respectively.

1.4.4   Schedule feasibilities (within timeframe)

The time constraint for this project can be specifically provided for respective phase of development. Based from the timeframe below, the project is concluded as timely feasible.

- FYP 1 (September – December 2012)
  - Data gathering
  - User acceptance and rough idea on the project
- FYP 2 (January – April 2013)
  - Development of the prototype
  - Testing and changes to application
  - Evaluation
  - Testing
  - Evaluation and Documentation

CHAPTER 2

LITERATURE REVIEW

2.1 Data Communication and Networking

2.1.1 Understanding Data Communication and Networking

Nowadays, our daily activities are improved by data communication and networking. There are so many important activities that require fast and accurate data transfer, especially business. Why should wait for weeks for a report to be sent across country over conventional mail if we can receive it almost instantaneously through computer network? This example shows how important it is data communication and networking in current globalization era.

Research in data communication and networking has resulted in new technologies. According to Forouzan (2007), the goal of data communication and networking is "to be able to exchange data such as text, audio, and video from all points in the world". The usage of internet in order to download and upload information quickly and accurately is very important in order to ensure better production over time.

Sharing of information is the essential of communication. Nowadays, sharing process can be done locally or remotely. The term telecommunication means communication at a distance, which was derived from Greek words (tele is Greek for "far"). Referring to Forouzan (2007), the word data refers to "information presented in whatever form is agreed upon by the parties creating and using the data". Data communications are defined as the exchange of data between two devices through form of transmission medium such as wire cable.

According to Forouzan (2007), "a network is a set of devices (often referred to as nodes) connected by communication links". A node can be any device capable of sending data generated by other nodes on the network such as computer, printers, and et cetera.

2.1.2 Challenges in Data Communication and Networking Teaching Process

There are certain issues need to be highlighted when we are discussing about the issues of Data Communication and Networking. One of the important issues that were highlighted by Chang (2004) was the problem faced in teaching data communication and networking. He has outlined some important issues that need to be considered when teaching data communication and networking based from his research and teaching experiences at the Hong Kong Polytechnic University.

One of the important issues is that the principle underlying Computer Networking and intrinsically very complex. The layered model in teaching DCN helps the students to understand and manage the complexity. But soon students will realize that this layering approach is inadequate in learning DCN. For example, the layers are not really independent from each other, and a network layer can be degenerated into a data-link layer. Because of this, understanding the whole picture is actually a challenge for most students.

Secondly, DCN concepts and protocols are also very abstract for students understanding process. Most of the students in the class don't have any experience in using typical networking equipments, thus visualizing a typical networking devices is already a challenges for students. Moreover the understanding of packets and protocols in DCN are also very abstract for students. Learning process that occurred in labs help a little, but it may not help students to conceptualize other more abstract concepts on their own.

In addition, the resource provisions for hands-on practical experience in DCN are very limited. Computer Networking laboratories usually has a ready-to-use computer network in which students can conduct experiments and other learning purposes. However, students are expected to be able to know how to set up their own network from scratch from the learning process. But it is not an easy task as student actually are lacking in term of real problem exercises. Besides, students also don't have the resources needed for them to build their own personal network outside the labs session.

2.2 Mobile Learning Theory

2.2.1 What is Learning Theory?

Learning theories are conceptual frameworks that describe how information is absorbed, processed, and retained during learning. There are three main categories of learning theories, which are Behaviourism, Cognitive, and Constructivism. On the other hand, Merriam and Caffarella (1991) have outline four main components of learning theory which are Behaviourist, Cognitive, Humanist and Social and Situational.

For Behaviourism, learning is the process of acquisition of new behaviour through conditioning. It focuses mainly on the objectively observable aspects of learning. Cognitivism on the other hand is a theory which looks beyond behaviour in order to explain brain based learning. It can be found in social role acquisition, intelligence, learning and memory as related to age. Further, constructivism is a learning process where the learner continuously builds or constructs new ideas and concepts. It emphasizes the importance of active involvements of the learners themselves in constructing knowledge.

Referring to Smith (2003), as per Merriam and Caffarella (1991), Behaviourist is the change in behaviour while Cognitivist is the internal mental process (including insight, information processing, memory, perception). Besides that, Humanist is defined as the personal act to fulfil their own potential, while Social and Situational is where the interaction or observation occur in social context. Basically, for Behaviourist, locus of learning is the stimuli in external environment, while for Cognitivist, the locus is the internal cognitive structuring. Humanist locus of learning is the affective and cognitive needs of the individuals, while for Social and Situational, its learning is focused in the relationship between people and environment.

There are so many learning theories that were derived from these fundamental theories. Some of them are absorbed for the implementation in mobile learning theories which will be discussed after this.

2.2.2 Learning Theory for M-Learning (Activity Theory)

Keskin and Metcalf (2011) had outlined the current available learning theories that can be applied as mobile learning theories. From the theories that were outlined by them, Activity theory was chose as the main learning theory for this project as its practicality suits well with the implementation for this research.

Activity theory is pioneered by Alexei Leont'ev and Sergei Rubinstein. This theory is more of descriptive meta-theory or framework than a predictive theory. The main component of Activity Theory can be described using the diagram below:
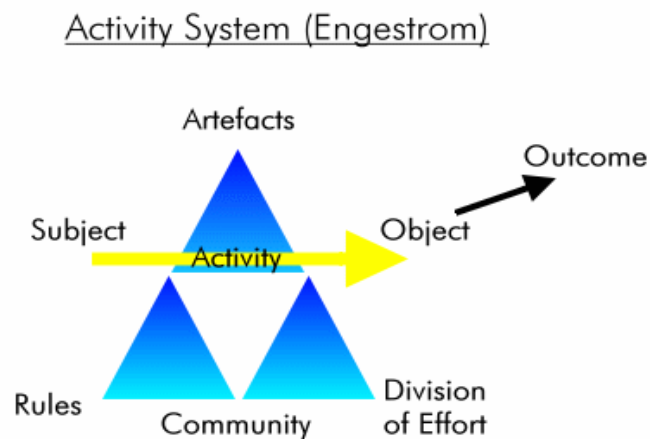
Figure 2.1 Activity Theory Model

This model is useful in order to understand how a wide range of factors work together to impact an activity. To reach the outcome, it is necessary to produce certain objects such as experience, knowledge and physical products. Human activity is mediated by artefacts which is the tool used in order to perform certain action. An activity is also mediated by community as the community may impose rules that affect the activity. The subject (students) work as the community to achieve the object, which is in this case, the understanding of DCN. From the concept of Activity theory, Engestrom analyze the collective activity through an expanded framework that shows the interactions between artefact-mediated activity and the cultural rules, community and division of effort.

2.2.3 Principles of Activity Theory

The principles of Activity theories are divided to four components as follows:

The first principle is object-orientedness. People live in a reality that is objective in a broad sense: the things that constitute this reality have not only the properties that are considered objective according to natural sciences but socially/culturally defined properties as well.

The second principle is internalization or externalization. Internal activities cannot be understood if they are analyzed separately from external activities, because they transform into each other. Internalization is the transformation of external activities into internal ones. Internalization provides a means for people to try potential interactions with reality without performing actual manipulation with real objects. Example is mental simulations, considering alternative plans, and others. On the other hand, externalization transforms internal activities into external ones. Externalization is often necessary when an internalized action needs to be repaired. It is also important when collaboration between several people requires their activities to be performed externally in order to be coordinated.

The third principle is mediation. Activity Theory emphasizes that human activity is mediated by tools in a broad sense. Tools are created and transformed during the development of the activity itself and carry with them a particular culture and historical remains from their development. So, the use of tools is an accumulation and transmission of social knowledge. Tool use influences the nature of external behaviour and also the mental functioning of individuals.

Lastly, the fourth principle of Activity Theory is development. In Activity Theory, development is not only an object of study, but it is also a general research methodology. The basic research method in Activity Theory is not traditional laboratory experiments but the formative experiment which combines active participation with monitoring of the developmental changes of the study participants. Ethnographic methods that track the history and development of a practice have also become important in recent work.

2.2.4 Framework for analyzing mobile learning based on Activity Theory
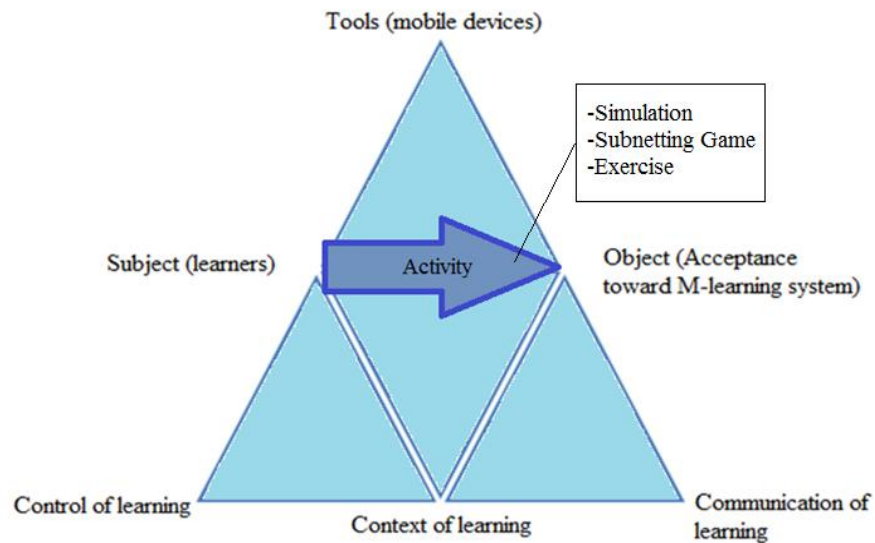
Figure 2.2 M-learning framework based on Activity Theory

According to Liaw, Hatala, and Huang (2009), the components of M-learning based on Activity theory are divided as three, which are the controls of learning, the context of learning, and the communication of learning.

For the control of learning, Activity theory enable learners to directly access learning materials conveniently in the addition of control of learning pace and style. From the M-learning perspective, the system will provide self-regulatory or autonomous learning functions. Besides that, learners can also use the systems personally and independently.

Regarding the context of learning, Activity theory consider context as the integral part of interaction and embraces the multiple communities of actors who interact around a shared objective. From M-learning perspective, the system will offer functions such as retrieval content of information, which is the sharing of knowledge. It also encourages and enhances the learners' usage.

In term of communication of learning, Activity theory enable user to adapt their communication and learning activities. Through M-learning, user will be able to have various interactions and communications to support the diversely learning process.

2.3 Advantages and Disadvantages of Mobile Learning

Mobile learning is chose for the improvement in learning DCN as it has few advantages that can be utilized. According to Mohamad, Maringe, and Woollard (2012), "the main motivation behind the deployment of mobile phones is education is mobility". Using mobile devices, students can actually access their lessons almost anywhere and at any time.

Besides that, mobile phones can support learning as it can provide learners with bit size lessons that they can learn in shorter periods. This actually helps students to have better understanding regarding the subject rather than encouraging them to memorize the subject only. Besides that, based from the studies done by Mohamad, Maringe, and Woollard (2012), mobile phones also become motivational tools for students to be used in education. This is because students are motivated to learn using improved methods and platform.

In addition, through mobile learning, students can also personalize their learning experience. Mobile learning can be use to adapt to individual and diverse learners, hence there are an opportunity to support differentiated, autonomous, and individualized learning through mobile devices.

According to Liaw, Hatala, and Huang (2009), mobile learning can also improve the connectivity, as mobile devices enable connection to data collection devices, and to network. Consequently, this will improve the collaboration via real-time or instant connectivity for data gathering process.

The disadvantages of mobile learning are limited processing power, limited battery capacity, and the size of the mobile device. Current mobile device still have limited processing power as compared to the desktop. Hence the learning applications were limited to the processing power available on mobile devices. Furthermore, mobile devices also have limited battery capacity, where sometimes this issue become a headache for most of the mobile devices' users as their usage were interrupted by the power issue. Moreover, small size of the mobile device may also contribute to eye-strain and short-sightedness problem.

2.4 Android (Operating System)

2.4.1 What is Android?

Android is a Linux-based operating system which was design to support primarily touch screen mobile devices such as smartphones and table computers. It was initially developed by Android, Inc., which was sponsored by Google and was later purchased by them in 2005.

Android is an open source software and Google releases the code under the Apache License. The licensing scheme enables Android to be freely modified and distributed by any device manufacturers, wireless carriers and enthusiast developers.

Android has a large developer community that extend the functionality of the device, which written primarily in a customized version of Java programming language. Android has become the world's most widely used mobile device platform as the operating system is open-source, customizable, lightweight and can be operated on high tech device without developing one from scratch. It has also been used in other devices such as televisions, game consoles and others.

2.4.1 Why Android?

Why Android is used for this project? Basically, this project needs to be run on a platform which was accepted by wide range of users. Based on the statistics produced by Gartner (2012), Android is the largest used mobile platform as it holds 64.1% of the sales for mobile device as of August, 2012.
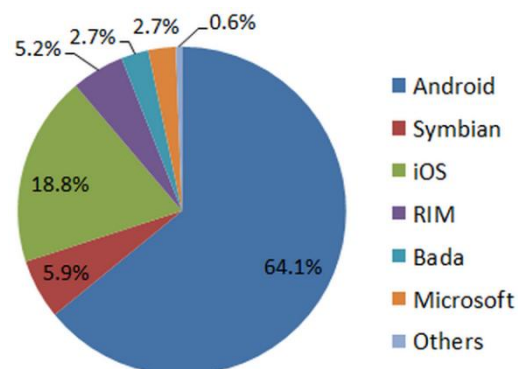
Figure 2.3 Sales of smartphone as of August, 2012

In addition, Android has steady growth in sales since it was deployed to consumers on November 5, 2007.
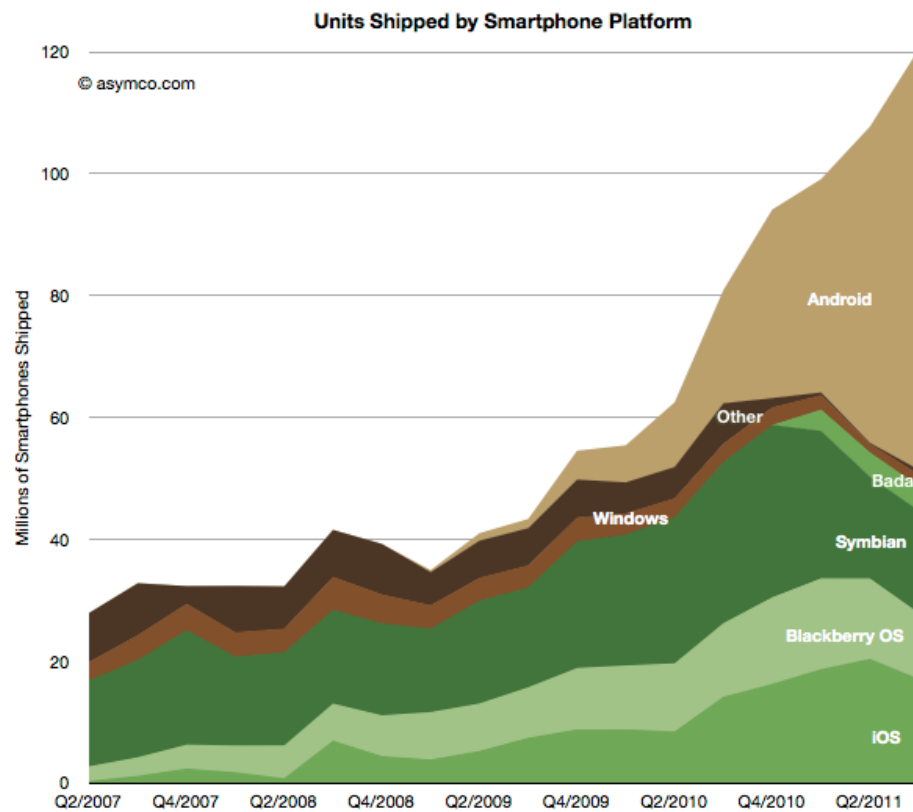
Figure 2.4 Smartphone shipped

This is actually important as it will ensure the sustainability of the applications' users. As we can see from the above diagram, the numbers of Android smartphones shipped are steadily increasing. Hence the application that will be developed will has wider range of user.

Besides, Android is an open-source operating system, thus the development on this platform will be much easier. In addition, there are also many enthusiasts that are sharing their ideas and are helping each other in the Android's community. Hence, the development of the project will be much easier with extensive resources available.

2.5 Current Learning Tools

Current learning process for DCN mostly involves theories in lectures, hence the learning process unable to attain students' attention as the lectures are less interactive. Furthermore, lectures are usually dominated by lecturers and less interaction from student involves.

According to Rodziah, Rosilah, and Zulkarnain (2012), some of the concepts in DCN are difficult to explain using whiteboard, but will be easier to explained and interesting to understand using graphics animation and simulation application. Because of this, they have tried to introduce Wiki, which is an e-learning process and materials in the process of teaching their students based on Web 2.0 technologies.

Besides that, Cisco has also provided interactive games in their websites to facilitate the process of learning DCN in order to become a certified network professional. There are many topics covered from the various choices of games provided, such as subnetting, binary game, simulation game, and etcetera. From the comments from the users of the games, we can see that the game actually helps them to understand better about DCN. Below are some of the games available at the Cisco Learning Network website.
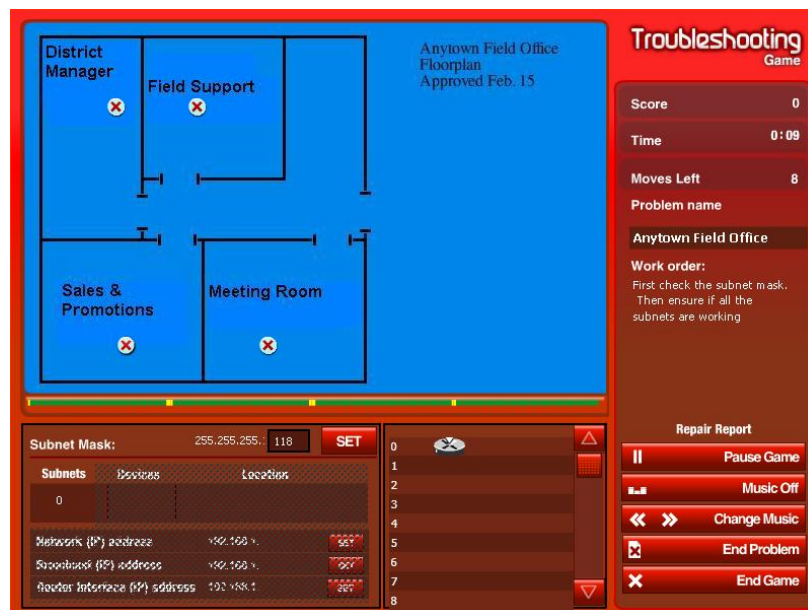
Figure 2.5 Subnetting Game

14
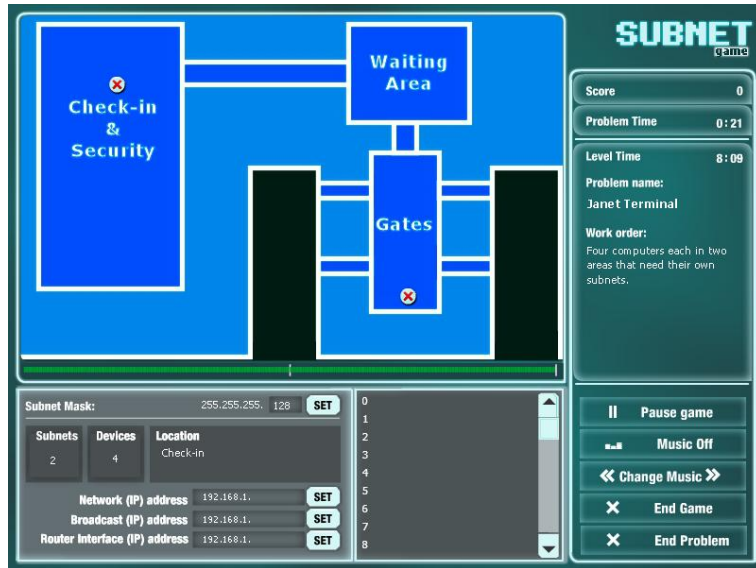
Figure 2.6 Subnetting Game 2
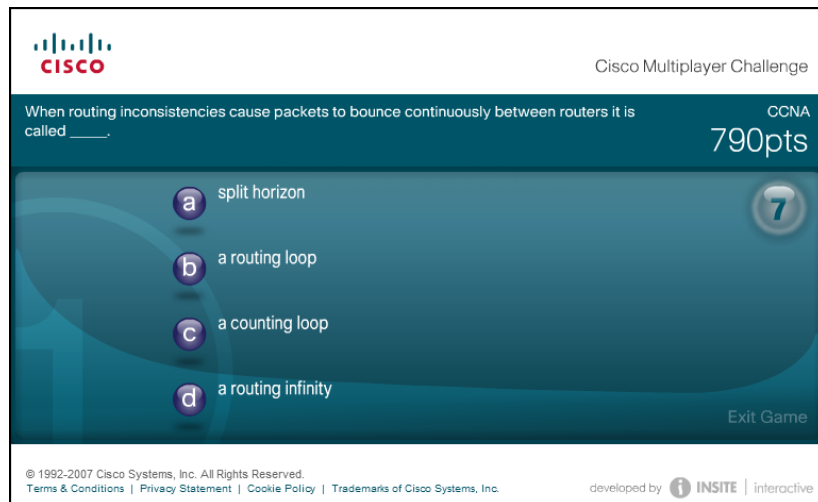
Figure 2.7 Interactive Exercises

Figure 2.8 Simulation Game

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Besides that, there are also network simulators available in PCs, such as GNS3, Packet Tracer, and others. These programs are able to provide students with practical exercise on building a network. Unfortunately, they are only available on PCs, but not mobile devices. Below are the screenshots from the previous mentioned programs.
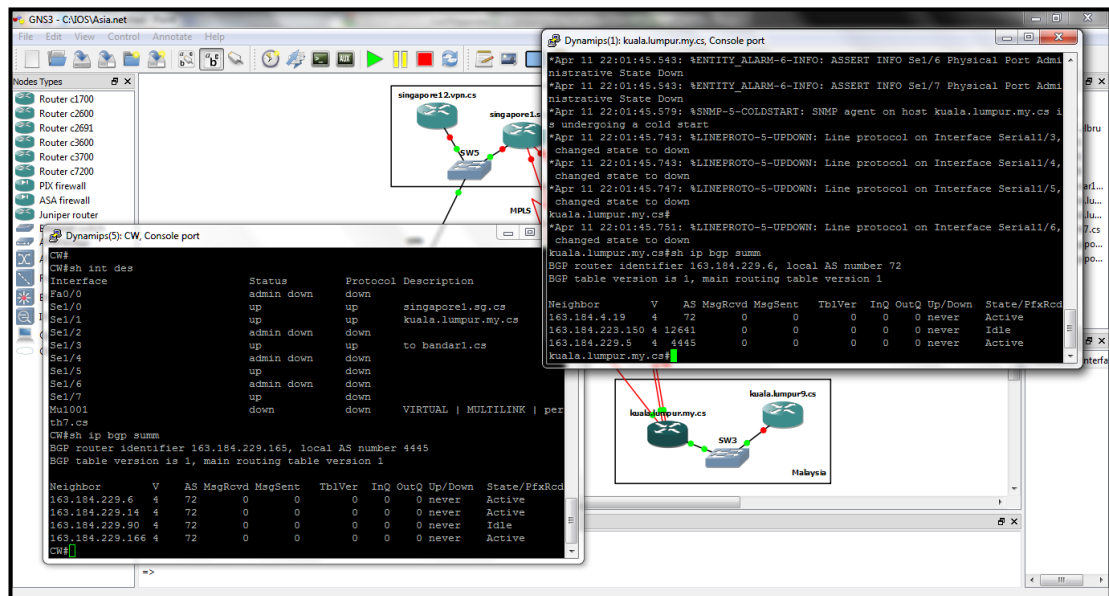
Figure 2.9 GNS3
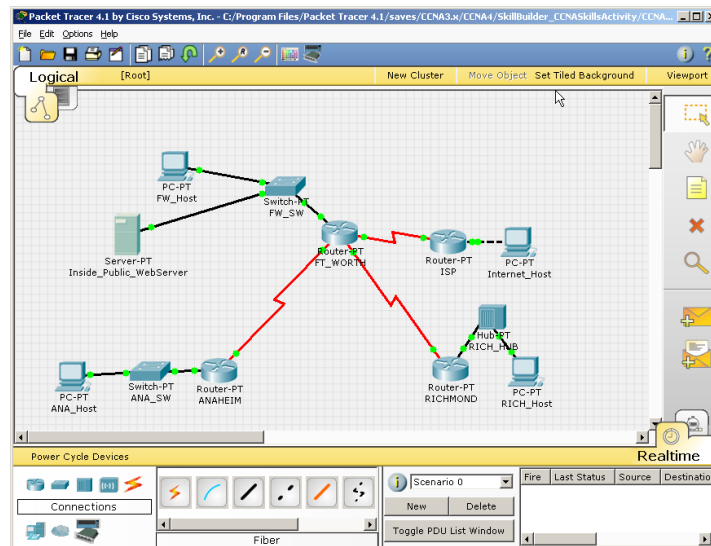
Figure 2.10 Packet Tracer

The ideas gains from the current available tools were absorb into the applications in order to build a great learning tools for the students.

CHAPTER 3

METHODOLOGY

In this research, there are two types of methodology used for the entire research process. Those are research methodology and also application development methodology.

3.1 Research Methodology
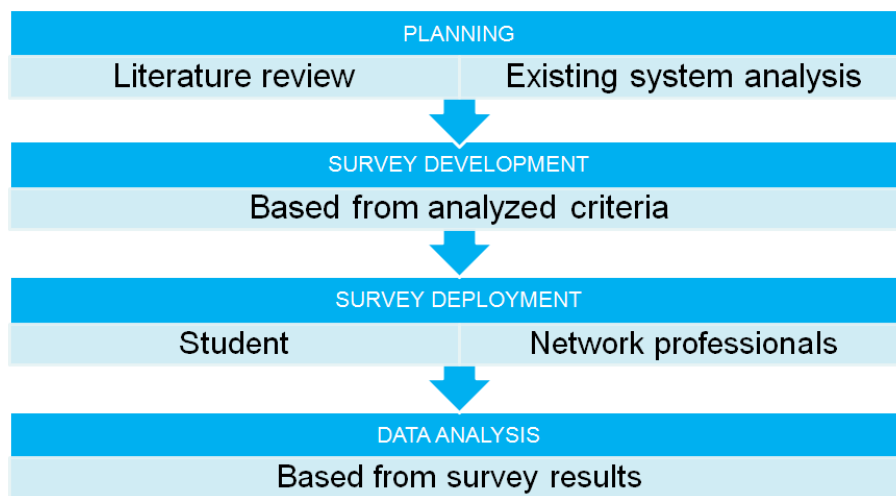
Figure 3.1 Research methodology

During planning phase, activities such as literature review and existing system analysis was done. Literature review was done to gain some insight about this project from scholars' perspective and also some valuable information that are important for this research. Existing system analysis was done in order to investigate what improvement can be done to current available DCN's learning platform and also to avoid any redundancy in the expected product.

Survey was developed based on the information gained from the planning phase and was deployed to the user, mainly students to study about their current perception towards DCN and also their acceptance for the expected product. Furthermore, the survey was also deployed to network professionals to gain some opinion from experienced individual in network. Data analysis was done based on the survey results before proceed to the application development phase.

3.2 Application Development Methodology
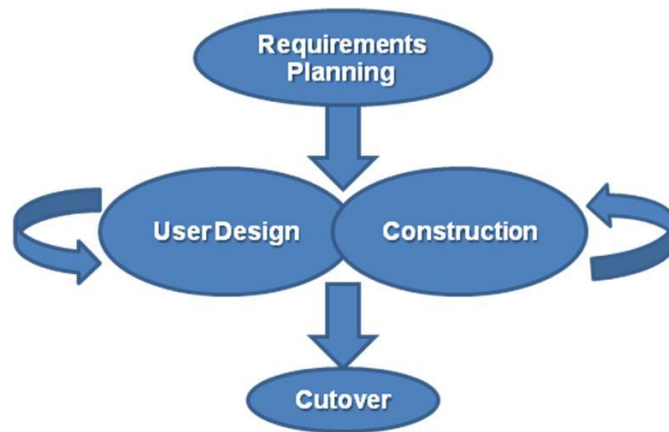
Figure 3.2 Rapid Application Development (RAD) Diagram

RAD is a development lifecycle that was designed to provide faster development, with a high-quality result, and with lower development costs while maintaining the quality. Because of this, RAD was chose to become the backbone of this research due to time constraint provided.

3.2.1 Requirements planning

Project scope, constraints and system requirement were defined for the project. Survey was also deployed in this phase to analyze the users' acceptance for the application, and also to grab some ideas and suggestion from professionals in network fields.

3.2.2 User Design

In this phase, the prototype and models was design to represent the system processes. The design is continuously analyzed, modify, and finally approve to be developed. Users' suggestion was also taken into account in this phase in order to pick the best prototype to be fully developed.

3.2.3 Construction

The application was developed in this phase. In RAD, users also participate in this process to suggest modifications and improvements. The tasks involved are programming and application development.

3.2.4   Cutover

The application was tested, users were train, and the old system will be run parallel to the new system for comparison process. All of these activities occur on an accelerated basis.

3.3 Key Milestone

Below are the key milestones for this project. The first activity need to be finished first before continue to the next phase.

Activities	Week
Selection of project's topic	1
Proposal submission and approval	2
Extended proposal submission	8
Proposal defence	14
Interim report submission	15

Table 3.1 Key Milestone for FYP 1

Activities	Week
Progress report	4
Pre-SEDEX	10
Dissertation	13
Viva	15
Technical Report and Final Dissertation	17

Table 3.2 Key Milestone for FYP 2

3.4 Gantt Chart

A Gantt chart was created earlier to organize and plan the whole research process. After certain issue that affect the earlier plan, the Gantt chart was modified to adapt the changes for this project. (*Refer Appendices A for better view*)

Tasks/Week	Sep 1	2	3	4	Oct 5	6	7	8	Nov 9	10	11	12	Dec 13	14	15	16	Jan 1	2	3	4	Feb 5	6	7	8	Mar 9	10	11	12	Apr 13	14	15	16	Mei 17	18
Selection of Project's Topic	*	█																																
Proposal Submission and Approval			█	*																														
Literature review				█	█																													
Existing system analysis						█	█																											
Extended Proposal Submission								*																										
Survey Development									█	█																								
Survey Deployment											█	█																						
Data Analysis													█																					
Proposal Defence														*																				
Interim Report Submission																*																		
Prototyping																	█	█	█															
Development																			█	█	█	█	█	█										
Progress Report																				*														
Testing proces																						█	█	█	█									
Pre-SEDEX																										*								
Dissertation																											█	*						
Viva																													█	*				
Technical Report																																	*	█
Final Dissertation																																	█	*

Final Year Project 1 (September – December, weeks 1–16); Final Year Project 2 (January – Mei, weeks 1–18). Milestone : *

Table 3.3 Gantt chart

3.5 Tools Required

- Main platform
  - App Inventor
    - Advantage: Simpler compared to other tools, hence easier to develop application.
    - Disadvantage: Limited usage and flexibility in term of application development.
- Android Emulator
- Adobe Photoshop
- Samsung Galaxy Tab 7.7 (Testing device)
- Android 4.0

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Literature Review Findings

From the literature review, we can conclude the following features:

- DCN is actually a hard subject as student unable to grasp the fundamental concepts.

- Practical approach is important in order to help the students to have better understanding about the subject.

- Resource issues in the current learning process can be solved if the user has another personal platform to learn the practicality of DCN.

- Activity theory is suitable to be implemented in this project. User (subject) can have extensive activity through the mobile device (artefact) in order to achieve the object (acceptance in M-learning of DCN).

- Android is the most suitable platform for this project as it is open-source, customizable and has extensive resources.

4.2 Survey Results and Discussions

Please refer to Appendices B to view the highlights of the responds received.

Section 1: Background Information

1. Gender

Male	**52**	52%
Female	**48**	48%
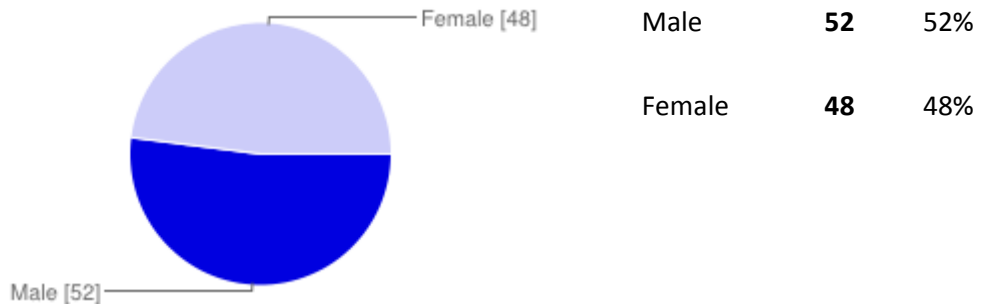
2. Age
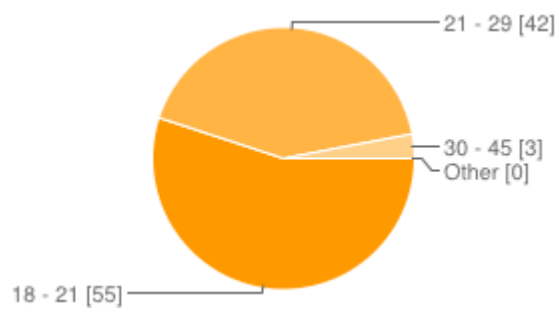
Age	Count	%
18 - 21	**55**	55%
21 - 29	**42**	42%
30 - 45	**3**	3%
Other	**0**	0%

3. Current job
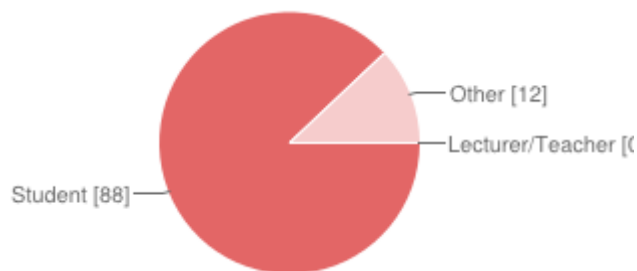
Job	Count	%
Lecturer/Teacher	**0**	0%
Student	**88**	88%
Other	**12**	12%

4. Level of knowledge in network/DCN.
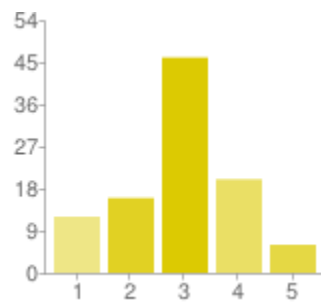
Poor   Good

		Count	%
1 -	Poor	**12**	12%
2		**16**	16%
3		**46**	46%
4		**20**	20%
5 -	Good	**6**	6%

Section 2: Mobile Application for learning DCN

1. Mobile learning will be more interactive and interesting compared to the conventional way of learning.
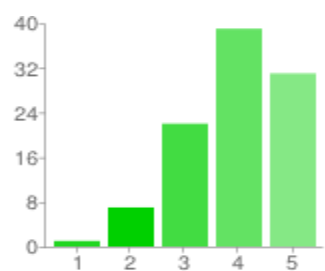
Disagree   Agree

		Count	%
1 -	Disagree	**1**	1%
2		**7**	7%
3		**22**	22%
4		**39**	39%
5 -	Agree	**31**	31%

2. The conventional way of learning network (focusing on theory) is enough to help you understand DCN.
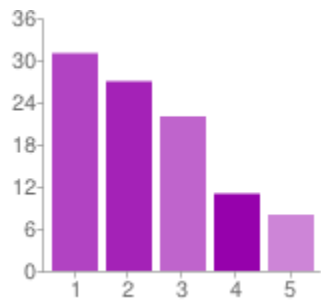
1 -	Disagree	**31**	31%
2		**27**	27%
3		**22**	22%
4		**11**	11%
5 -	Agree	**8**	8%

Disagree   Agree

3. A mobile learning application will helps you to learn in more flexible and relaxed time (not bounded to fixed schedule).
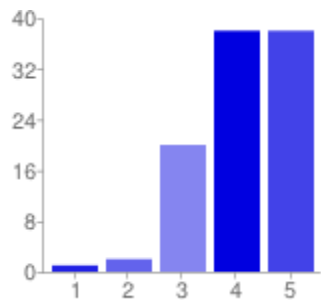
1 -	Disagree	**1**	1%
2		**2**	2%
3		**20**	20%
4		**38**	38%
5 -	Agree	**38**	38%

Disagree   Agree

4. A mobile learning application will helps you to learn in more flexible space (geographically).
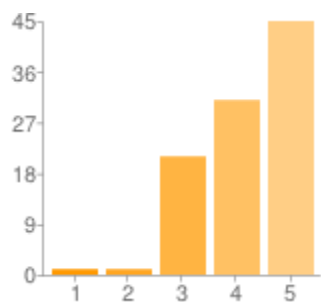
1 -	Disagree	**1**	1%
2		**1**	1%
3		**21**	21%
4		**31**	31%
5 -	Agree	**45**	45%

Disagree   Agree

5. The usage of multimedia (mobile application) will helps you to retain your interest in the learning process.
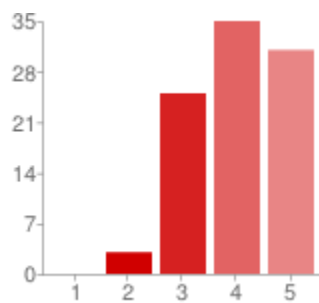
1 -	Disagree	**0**	0%
2		**3**	3%
3		**25**	25%
4		**35**	35%
5 -	Agree	**31**	31%

Disagree   Agree

6. Referring to mobile applications below, which one is the best way to help you understand better about DCN?
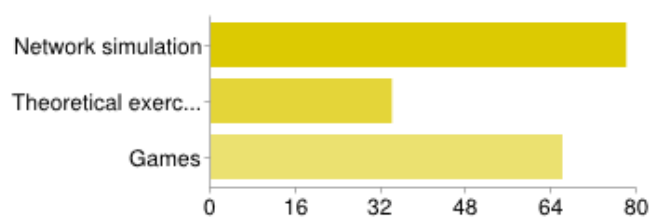
Network simulation	**78**	78%
Theoretical exercises	**34**	34%
Games	**66**	66%

People may select more than one checkbox, so percentages may add up to more than 100%.

Based from the preliminary survey results, we can conclude that the students are actually having hard time in learning DCN. Many students are unable to strengthen their basic knowledge in DCN, thus DCN become a very difficult subject to them. In addition students are also unsatisfied with current learning process of DCN where the practicalities are found as trivial, and lectures are usually focused on theories. Students also fail to understand what been taught in the labs by the tutor as they were unable to relate and implement all the theories that have been taught in lectures in practical way.

Besides that, network professionals such as network engineers and network analyst suggest that the development of simulation in learning network is a great way to learn DCN as students will be able to understand how the network actually works in real life operation. In addition, add on advantages such as mobility in using mobile device is also improving the steps in learning DCN.

In addition, majority of the respondents prefer simulation as the main content for the expected application. The above diagram shows that students are also interested in having games for the application and also complementary interactive exercises for the application.

From the survey we can conclude that users are giving positive reaction towards this project, which portray a good acceptance for the expected product. Users are also excited with the new platform for learning in DCN, which is the improvement for current learning process.

4.3 Expected Product

Below are the samples of expected product that will be developed.
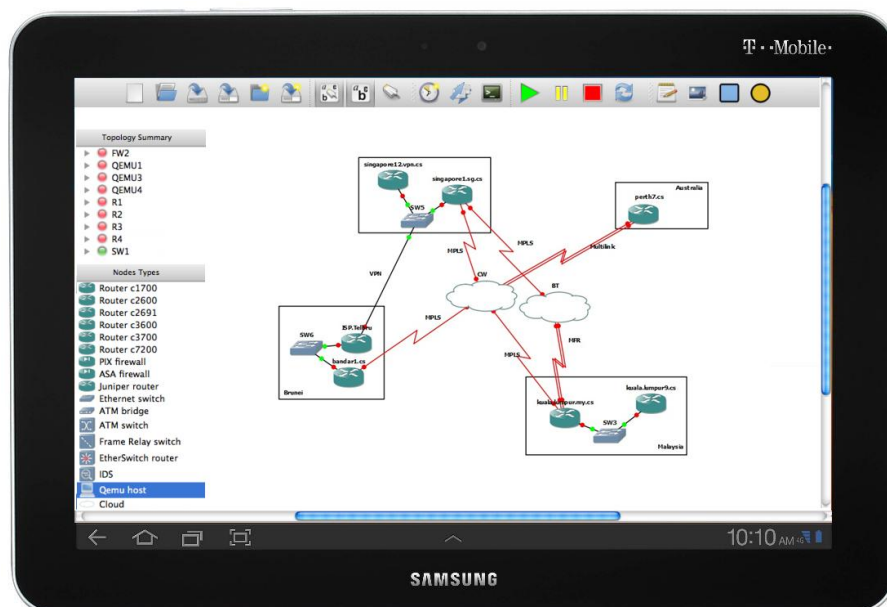
Figure 4.2 Expected product

The expected product above shows a simulation of network in a tablet. However the whole application is expected to include minor games and also interactive exercises in order to ensure well-rounded learning process.

4.4 Prototype Sketches

The sketches are done in order to get the basic view of how the application will look like and how the interface will be build. Below are the rough sketches for the application that was done before the programming process start.

Figure 4.3 Main Screen

Simulation
→ Main content
→ Button to pick router
→ 3 types of connection
   → P2P
   → VPN
   → Multilink/MFR
→ Instruction screen.

1)
Canvas / Router connection
Connection buttons.
IP address
IP address.
OK button.
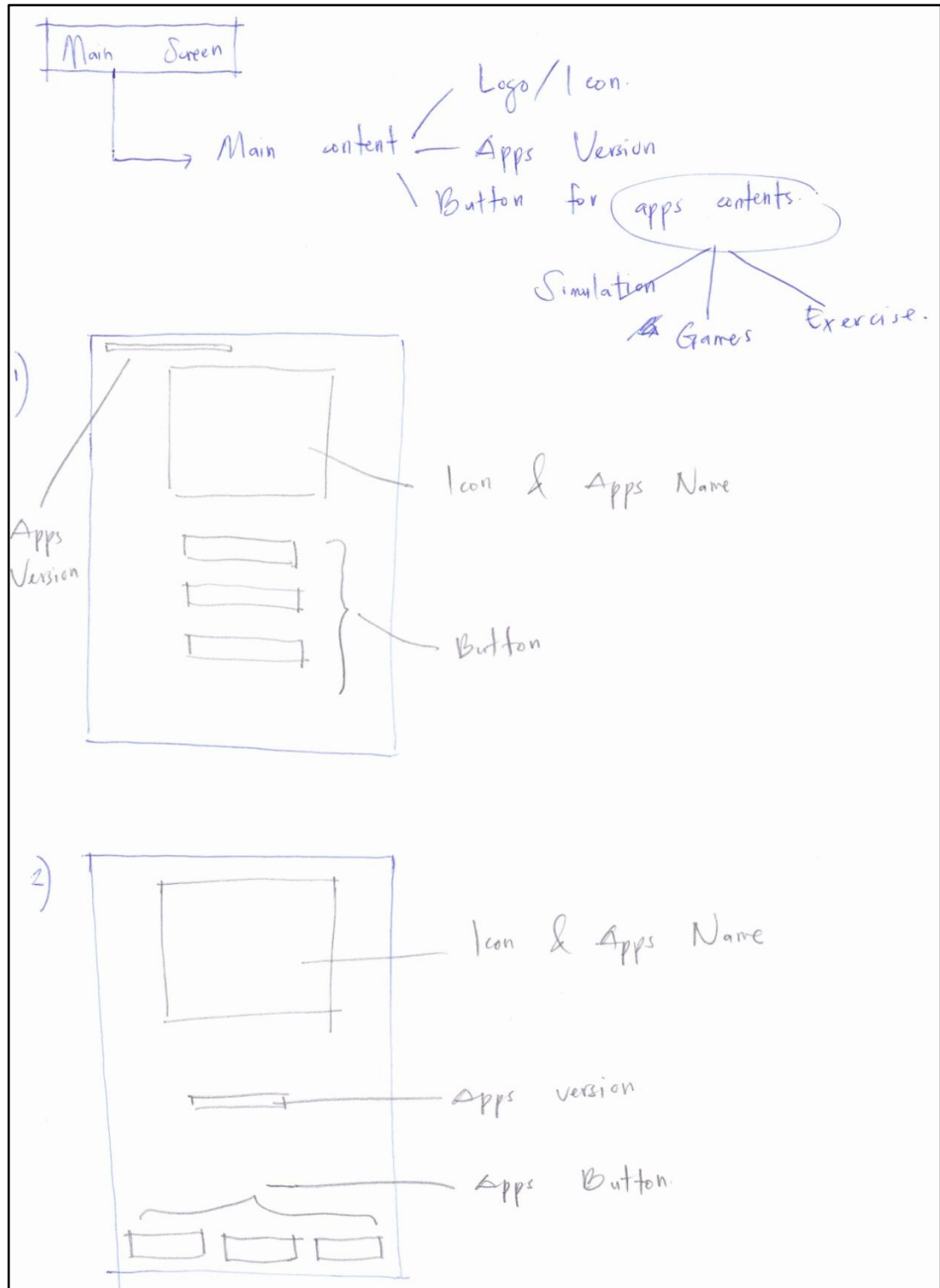
2)
Connection button
Canvas.
IP address
OK button
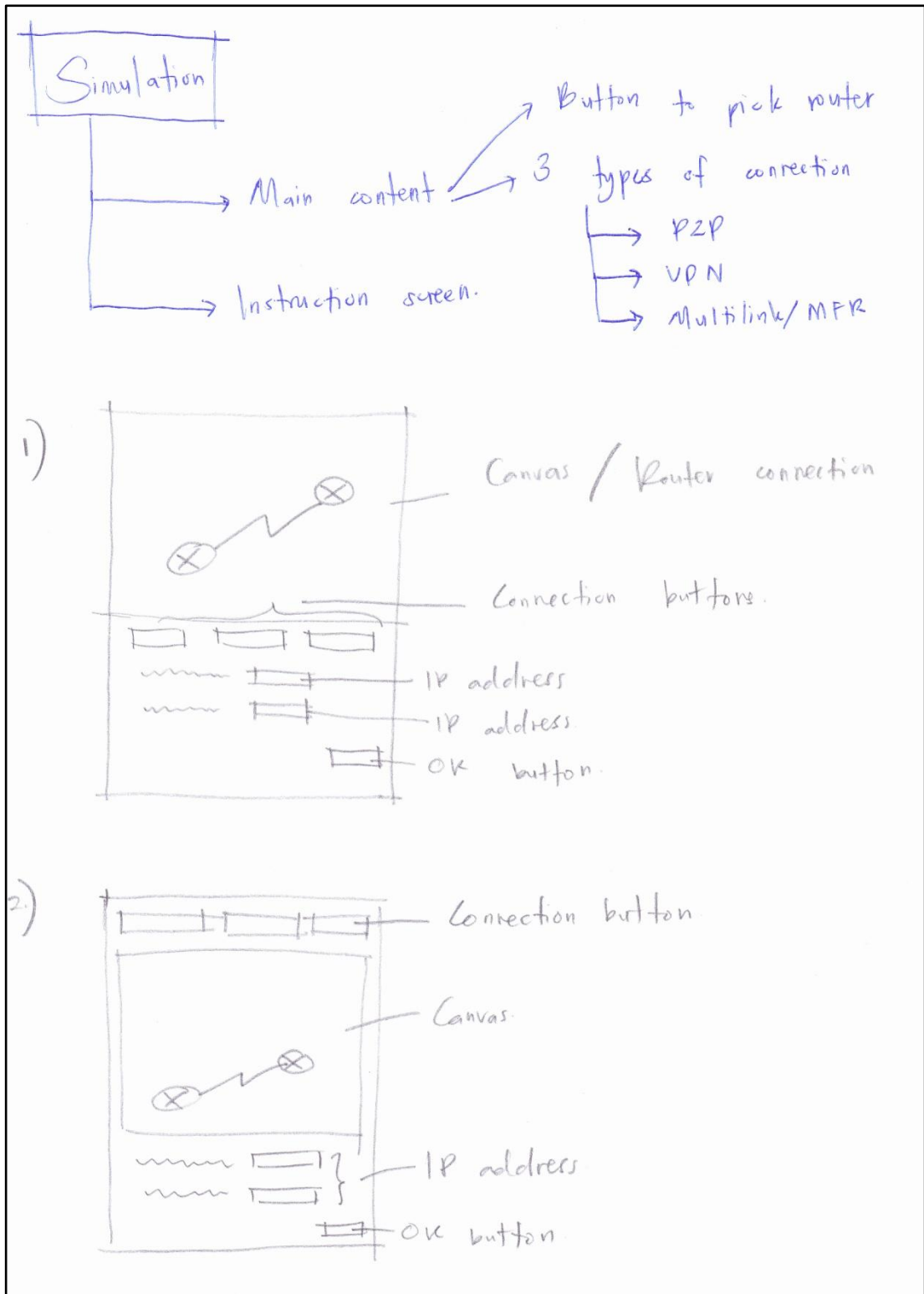
Figure 4.4 Simulation screen sketch

27
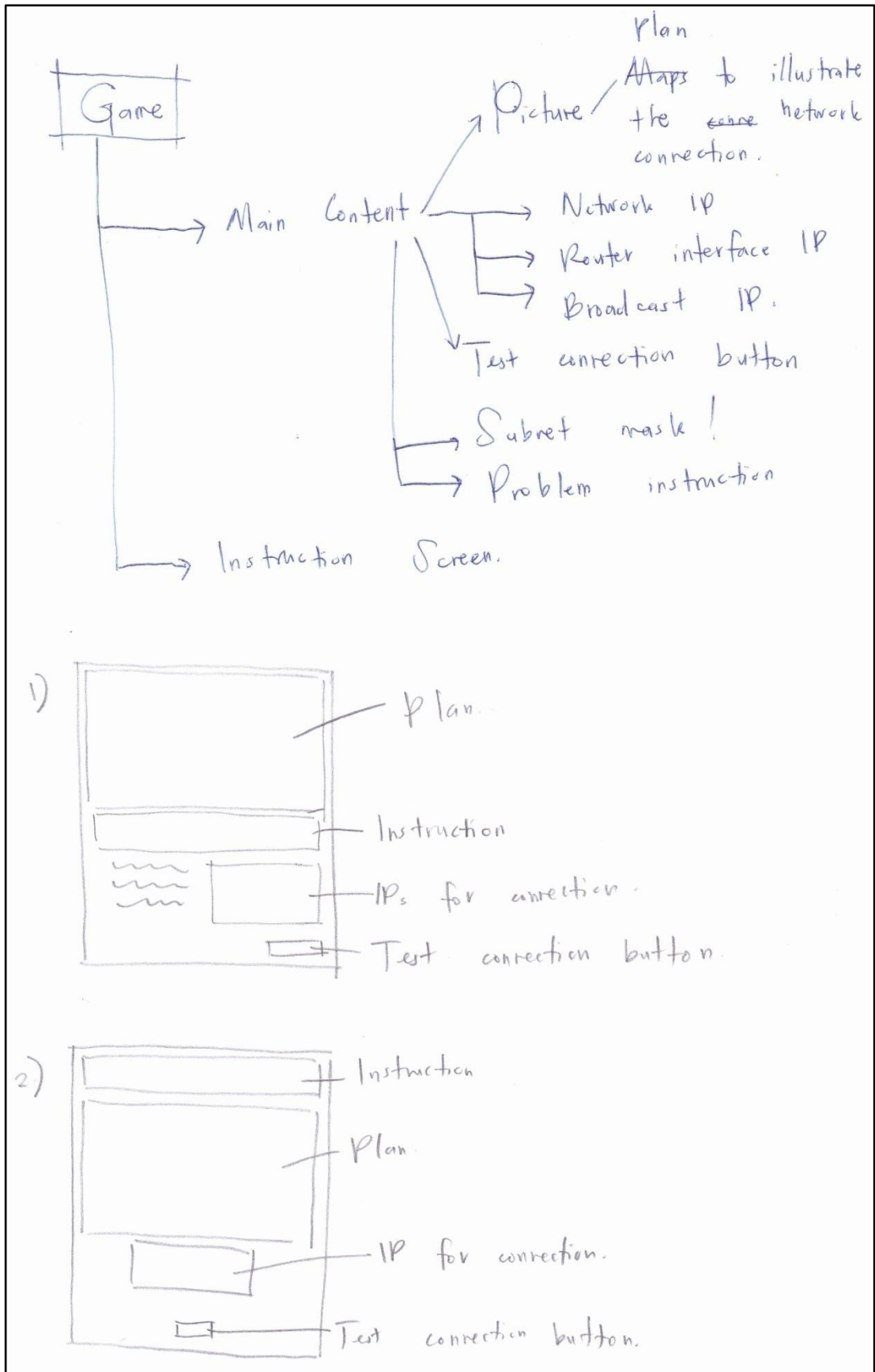
Figure 4.5 Game screen sketch
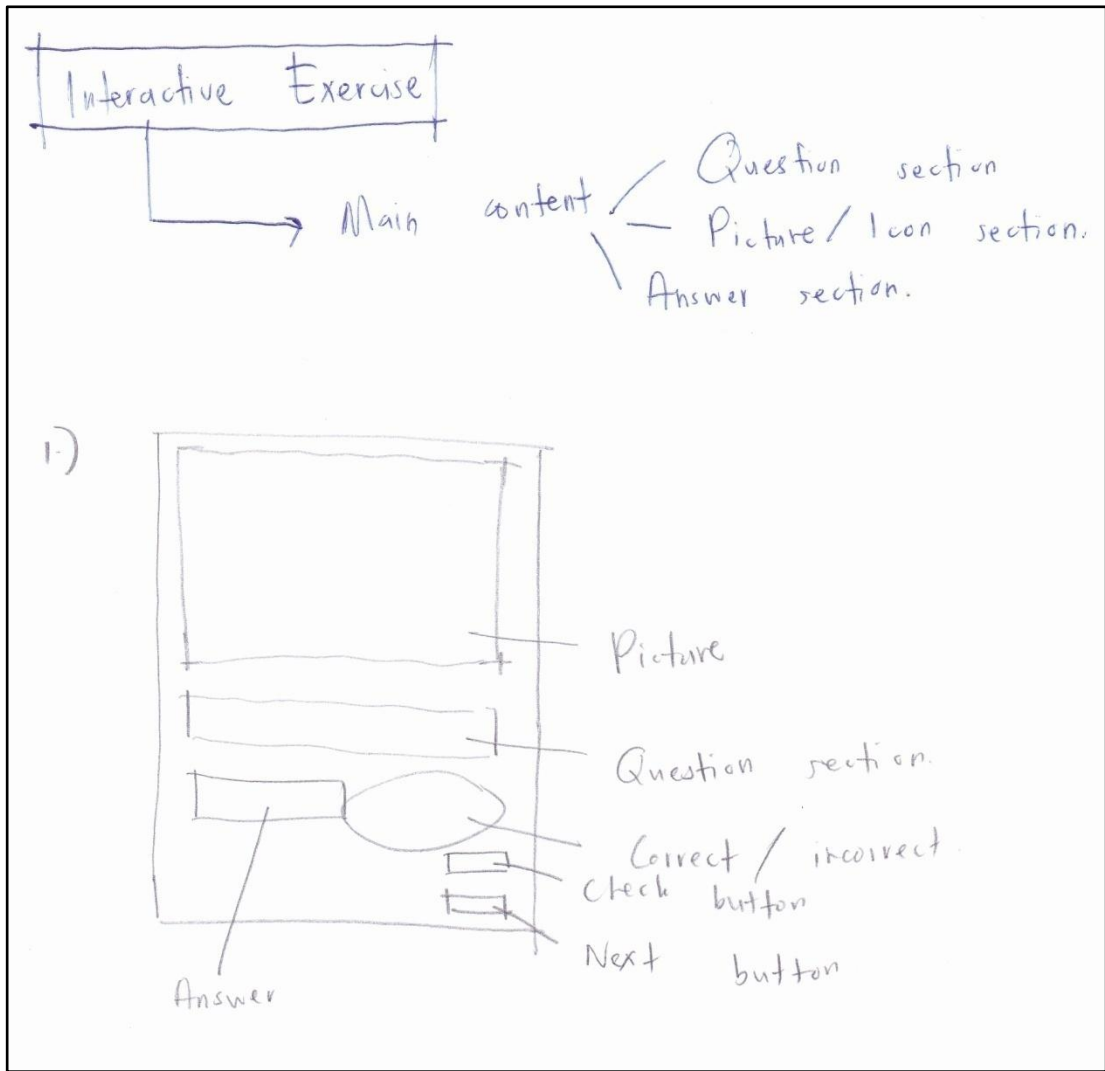
Figure 4.6 Exercise screen sketch

4.5 Prototype of Application

The prototype and the interface of the application was developed using App Inventor and Adobe Photoshop. Testing was also done in the prototype development process in order to choose the best interface for the application. Following figures are some of the prototype that was created in the process of developing the application.

4.5.1 Main Screen Screenshot
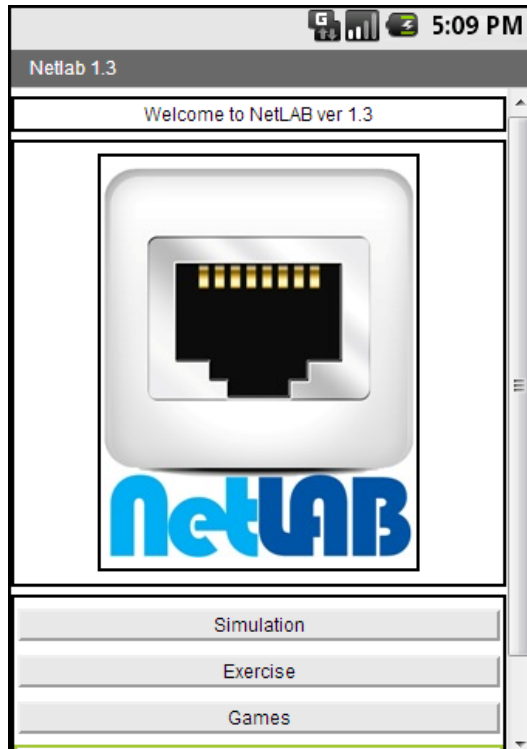
Figure 4.6 Main Screen 1

Figure 4.7 Main Screen 2

4.5.2 Router Simulator Screenshot
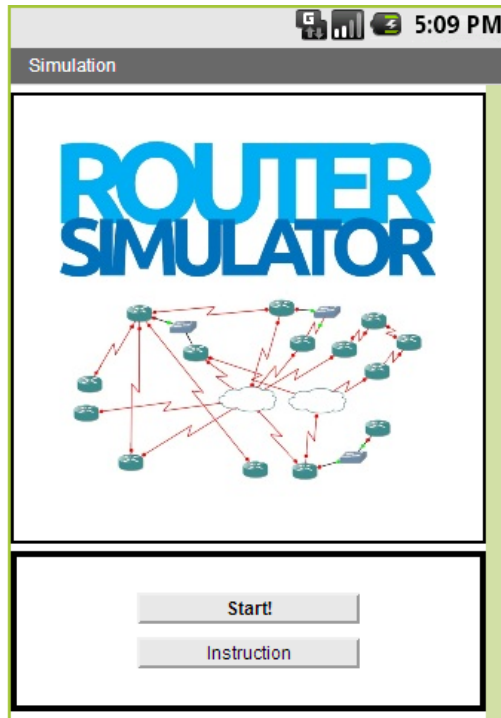
Figure 4.8 Router Simulator Start Screen
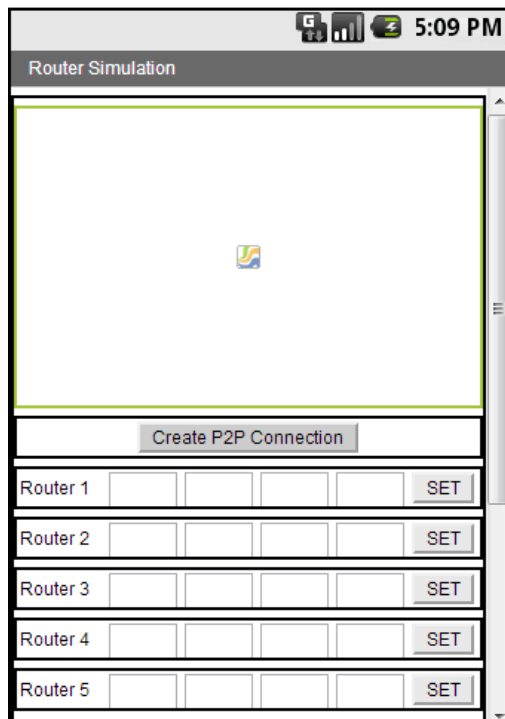
Figure 4.9 Router Simulator 1
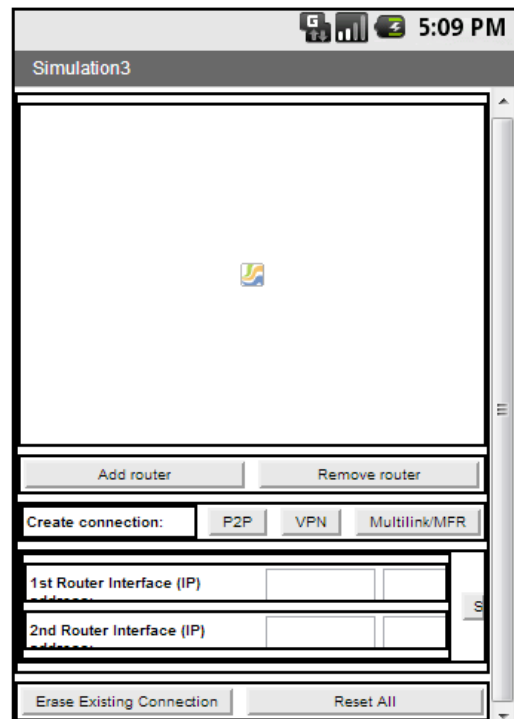
Figure 4.10 Router Simulator 2

4.5.3 Subnet Troubleshooting Screenshot
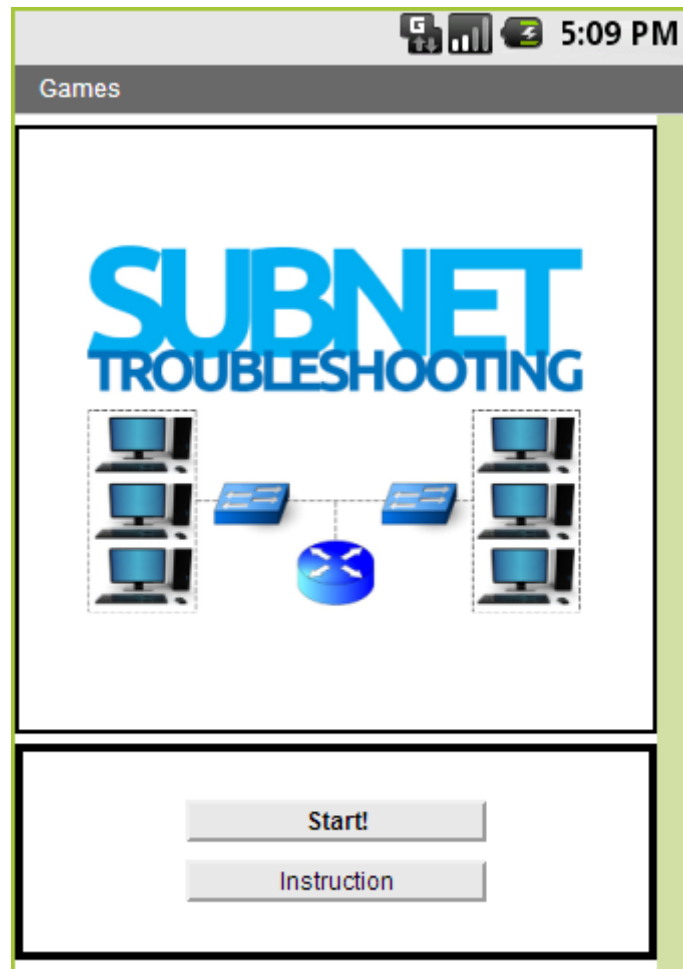
Figure 4.11 Subnet Game Start Screen
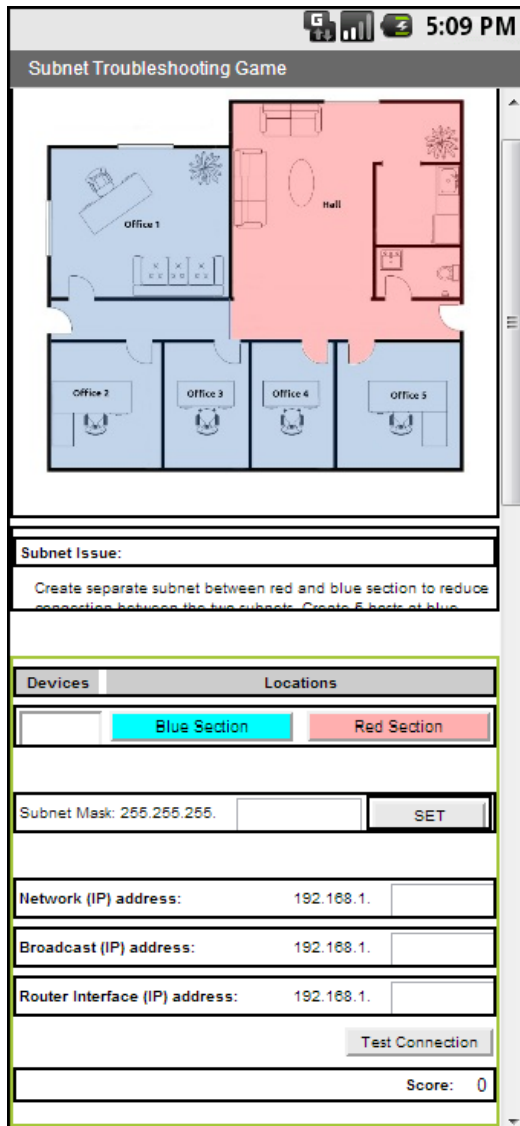
Figure 4.12 Subnet Game 1
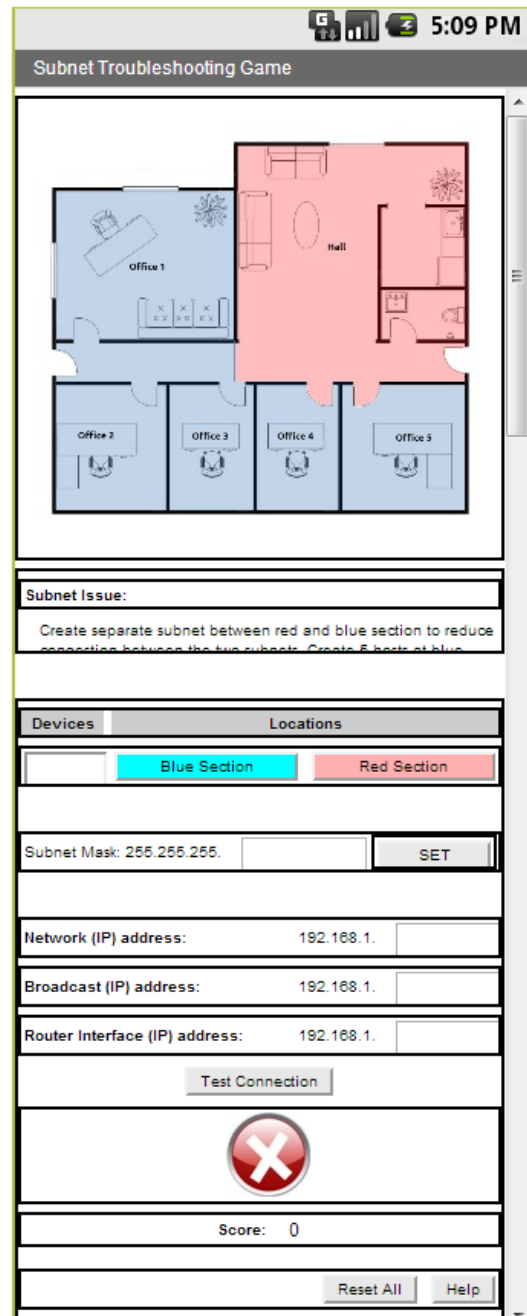
Figure 4.13 Subnet Game 2

4.5.4 Exercise Screenshot
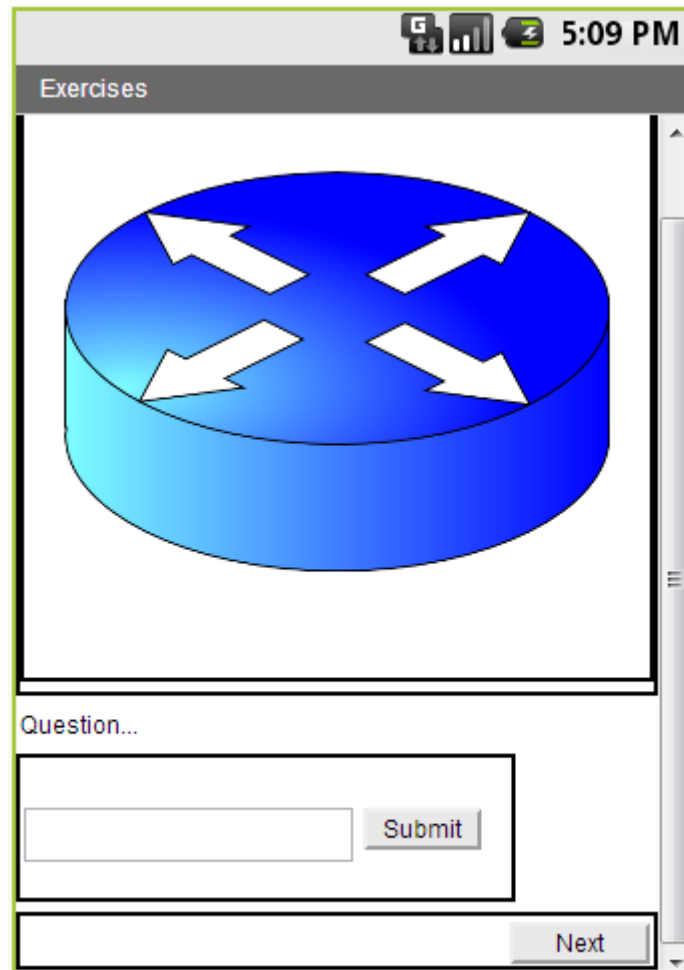
Figure 4.14 Exercise

4.6 Final Application

The following figures are the final application that was used to test the subjects (student) for this research. The final application interface was selected from numerous numbers of prototypes that were created during previous prototyping process.

Figure 4.15 Main Screen
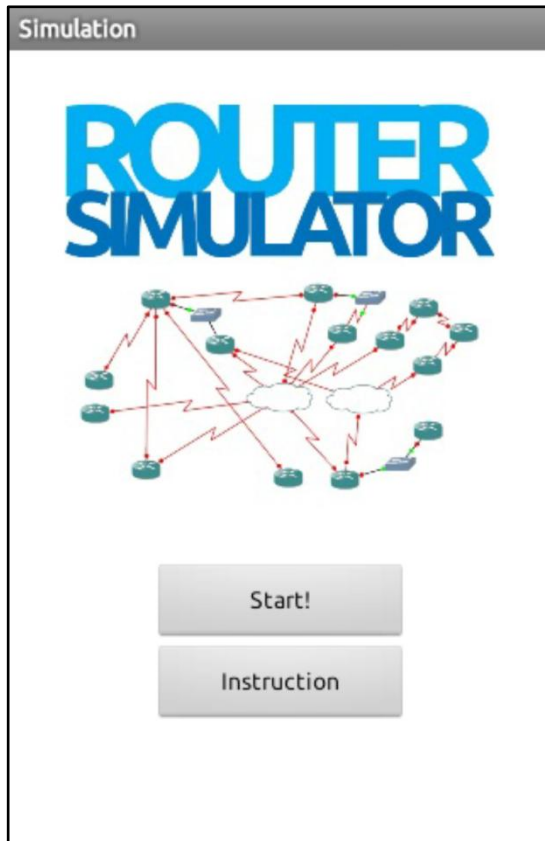
Figure 4.16 Router Simulator Start Screen
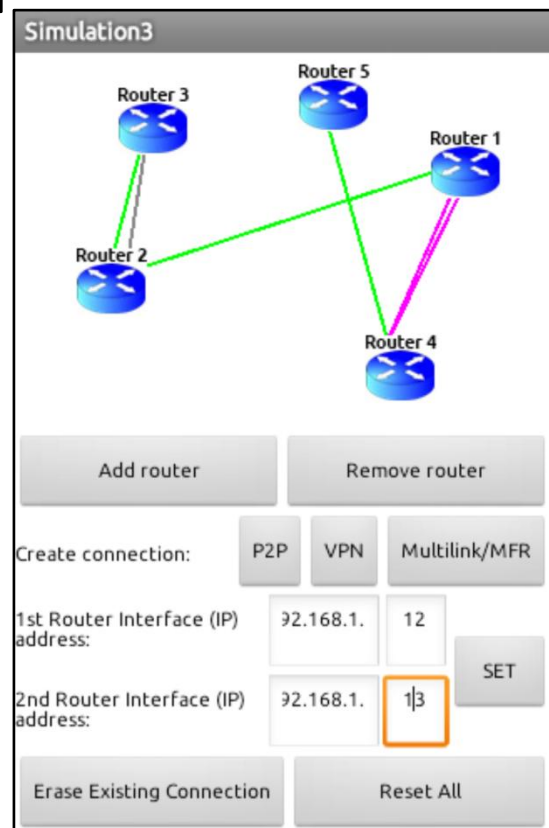
Figure 4.17 Router Simulator
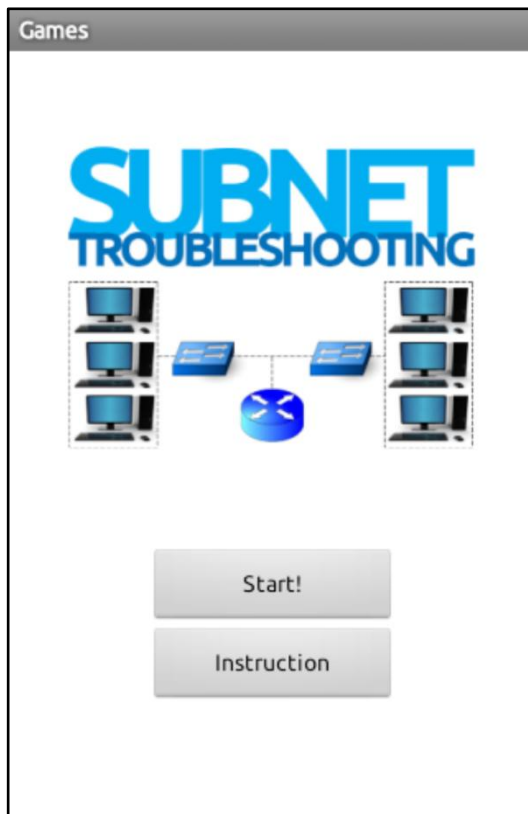
Figure 4.18 Subnet Game Start Screen
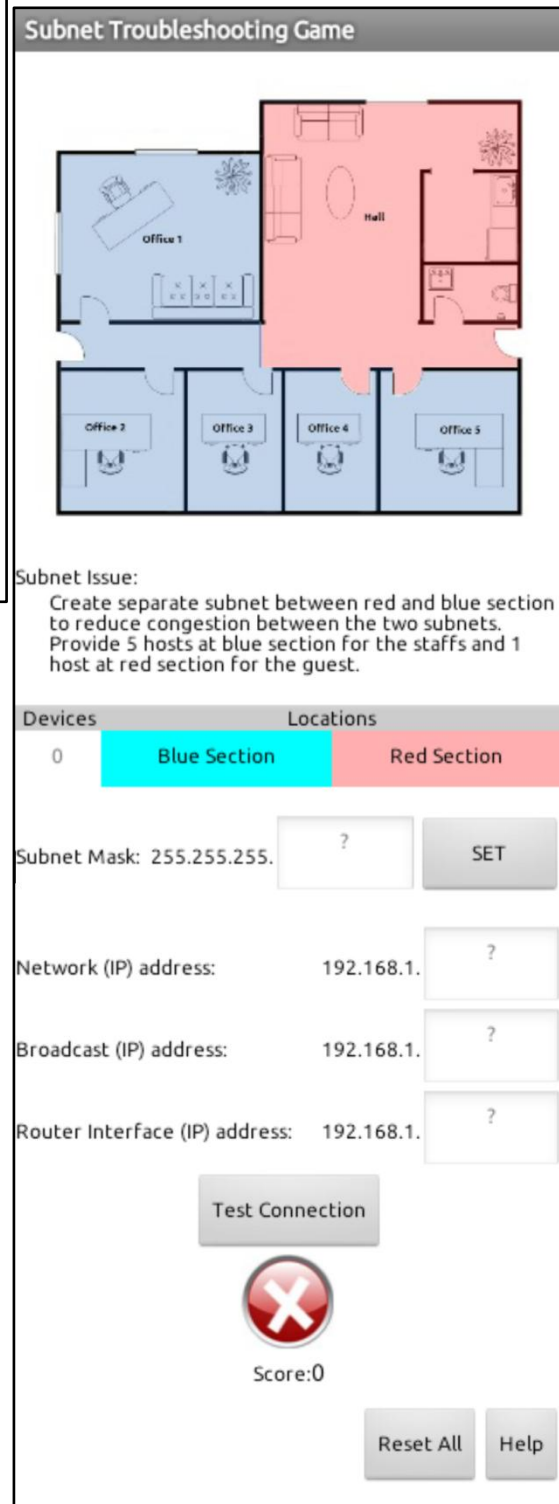
Figure 4.19 Subnet Game
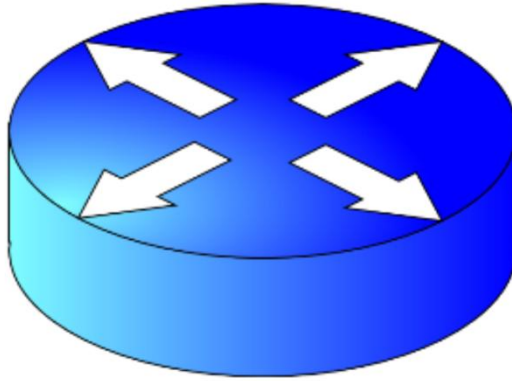
Figure 4.20 Exercises

4.7 Results from Testing Process

Please refer to Appendices C for the result of the test.

The testing process was done on 5 subjects, who are Information and Communication Technology students that have taken Data Communication and Networking course previously. Research objectives, testing purpose and the application functionality were explained to the subjects before the test was done. Below are the results from the previously done test.
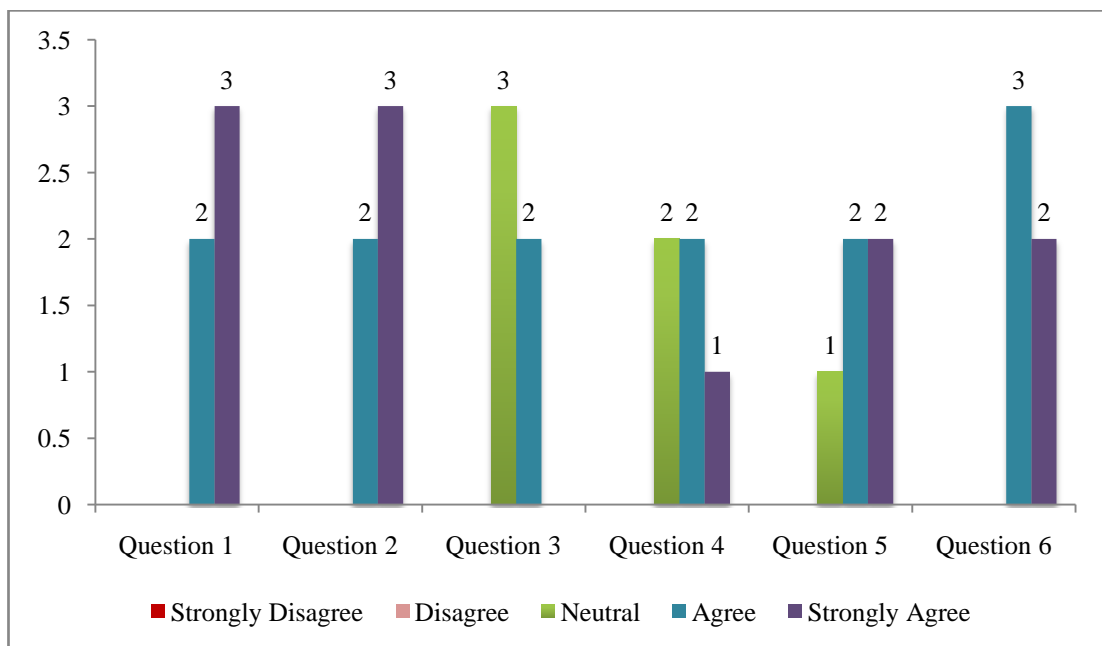
Figure 4.21 Result of the test

Question 1:   Did you find the application helpful in learning Data Communication and Networking?

Question 2:   From your opinion based on your experience in using the application, do you think that it will be able to complement the learning process, whether it is during class or not?

Question 3:   Do you able to understand the basic concept of networking based on the components that were included in the application?

Question 4:   Do you agree that the application will be able to complement the scarce resources in learning DCN?

Question 5:   Do you agree that the application helps you to understand the practicality of DCN in real life?

Question 6:   Please rate the application's overall level of usefulness in learning DCN.

From the result of the test above, we can conclude that the application was positively accepted by the students to complement their learning process in DCN. They actually found that the application is helpful to be one of the tools in the learning process of DCN.

Besides that, the students are positives that the application are suitable to be used for learning DCN no matter where they are, which means that it solve the time and place constraint problem that was previously faced by the students.

Moreover, the students agree that the application actually helps them to understand the practicality of learning DCN, and also aid the problem of the scarce resource in learning this subject. This test actually proves to solve the problem statement that we have outlined in the first place.

However, some of the students suggest that they still unable to fully grab the basic concept of networking, especially regarding the subnetting process after the test session. But they agree that it will be easier for them if more tutorials are included in the application to aid the learning process of subnetting, as it is actually a hard subject to be learned in an instant.

Overall, the students agree that the application was useful in learning DCN. But to provide students with better learning experience, the application can be improve by providing more tutorials and let the students have more time in exploring the application to let them have better understanding on how DCN actually works.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

DCN is one of the core subjects for Information and Communication Technology (ICT) students. Despite that, many students are unable to enjoy this subject and even having difficulties in understanding this subject. The outcome of this project is targeted to solve current issues which were stated earlier, with the additional improvement of current learning process. Furthermore, this project is in accordance with the mission to help provide the students with personal platform in learning DCN, where they can personalised their own learning process. Moreover the output of this project is targeted to improve the interaction among the students themselves and also with the lecturers while enjoying the learning process through the interactive learning platform.

For the recommendation part, this project should be expanded to other operating system platform in order to cherish the variation of mobile device and also to counter heterogeneity issue. Besides that, the application can also be improve by providing more tutorials to give the students better understanding and facilitate their learning process. The content of the application can also be increase and improve in order to provide the students with more real life applications example, hence improve their understanding on practicality of DCN in real life. In addition, the application should be translated to different language in order to reach global students that do not understand English or did not use English as their primary or secondary language. With this the application can help more students throughout the globe.

As the conclusion, this study had achieved the objectives outlined and also proves to be able to solve the problems that are faced by current students and lecturers. Hopefully this research delivery will be a great complementary tool for the learning process of DCN.

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APPENDICES A

Tasks/Week	Final Year Project 1																Final Year Project 2																		
	September				October				November				December				January				February				March				April				Mei	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Selection of Project's Topic	*																																	
Proposal Submission and Approval				*																														
Literature review																																		
Existing system analysis																																		
Extended Proposal Submission								*																										
Survey Development																																		
Survey Deployment																																		
Data Analysis																																		
Proposal Defence													*																					
Interim Report Submission															*																			
Prototyping																																		
Development																				*														
Progress Report																										*								
Testing proces																																		
Pre-SEDEX																												*						
Dissertation																																		
Viva																													*					
Technical Report																															*			
Final Dissertation																															*			

Milestone : *

44

APPENDICES B

Current job	Referring to mobile applications below, which one is the best way to help you understand better about DCN?	The conventional way of learning network (focusing on theory) is enough to help you understand DCN.	In your opinion, what is the important component in learning DCN (critical things that need to be known by ICT student)?	8. Please leave any comment here. :)
Executive	Network simulation, Games	1	The fundamentals of network infrastructurs, the methods of data transfers, technologies related to data transfer enhancement.	A simulation would help to aid study of dcn but strengthen the fundamentals to ensure the better grasp for more advance approach in dcn.
Student	Network simulation, Games	2	Understand how the network works and able to imagine the process is the most crucial part and through multimedia this can help in making the learning more understandable.	
Student	Network simulation	2	Basic hardware and software configuration and handling experience. Precise diagram to illustrate overall system architecture. Simplify the terms used in conveying information.	
Student	Network simulation, Games	1	the basic thingy. because even some of us do not understand the basic of networking	
Student	Network simulation, Theoretical exercises	1	The first thing that student need to know is how networking work/run. Thats can be achieve by showing an animation video of networking flow in LAN & wireless LAN. After that then students can understand each component easier as they know what each component function in a whole network	
Student	Network simulation, Theoretical exercises, Games	1	need to know what is networking n how its work.. teory in class n lab does not match at all.. so we cant understand it	
System Engineer	Network simulation, Games	1	in my opinion, dcn has the hardware level and software level where in the university focuses more on the theoretical part. i would like to suggest in the mobile application has some representation/implementation examples in the real world so that student get picture and understand data network rather then memorizing them.	
Student	Network simulation,	1	The alignment of the theory of the subject together with the lab session content.	

	Theoretical exercises, Games				
Student	Network simulation, Theoretical exercises, Games		1	Student must be given the opportunity to practice what is learnt by themselves and lecturer must emphasizes the importance of learning DCN in daily life. Only when the significance of DCN known, the learning will be fun, easy and interesting.	
Student	Games		5	apply the theoretical knowledge in practical	
Student	Network simulation, Theoretical exercises		2	Ethernet and Data Transmissions	DCN class in UTP (especially) required more practical works rather than theory.
Network Engineer	Network simulation		2	From my opinion, the most important component in learning DCN is to understand the basic concept of "how" the machines are connected to each other from the same, or different geography, & from different kind of access. ICT students also need to recognize the basic hardware component inside the network, know how they are work, & where are these devices sitting in the OSI layer; such as: router in network layer, switch in data link layer, etc. This understanding is fundamental to whoever has interest in network analysis, engineering, & architecture. Since network simulation is one of the best way to help student to understand better about DCN, I would strongly encourage if there's an interactive network simulation application can be developed for mobile apps, so the process of learning will continuously progressing, not limited by time frame & location.	Despite of learning DCN theoretically in University, ICT students need to get exposed with the networking product itself, because in the end, whoever going to pursue their career in technical field after their graduation, they don't have much choice except to work & familiar with the product. This can be done earlier by mastering the module & course of the product, or get an hands on experience during internship.
Student	Network simulation, Theoretical exercises, Games		1	in my point of view, practicality is the most important aspect in understanding DCN. in practical you can enhance it with something is more interesting like games and pop quiz.	In teaching DCN try to include some security terms like hacking just for the sake to make it sounds interesting to learn. The lecturer in UTP really need to simplify the lengthy slides and use analogy to explain complex topic such as comparing a town with only one gate to a situation of explaining gateway in network. that way student will understand more.

NetLAB : Mobile Application for learning DCN

Software Testing

1. Did you find the application helpful in learning Data Communication and Networking?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ○   ●

2. From your opinion based on your experience in using the application, do you think that it will be able to complement the learning process, whether it is during class or not?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ○   ●

3. Do you able to understand the basic concept of networking based on the components that were included in the application?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ●   ○   ○

4. Do you agree that the application will be able to complement the scarce resources in learning DCN?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ○   ●

5. Do you agree that the application helps you to understand the practicality of DCN in real life?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ●   ○   ○

6. Please rate the application's overall level of usefulness in learning DCN.

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ○   ●

NetLAB : Mobile Application for learning DCN

Software Testing

1. Did you find the application helpful in learning Data Communication and Networking?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ●   ○

2. From your opinion based on your experience in using the application, do you think that it will be able to complement the learning process, whether it is during class or not?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ●   ○

3. Do you able to understand the basic concept of networking based on the components that were included in the application?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ●   ○   ○

4. Do you agree that the application will be able to complement the scarce resources in learning DCN?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ●   ○   ○

5. Do you agree that the application helps you to understand the practicality of DCN in real life?

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ●   ○

6. Please rate the application's overall level of usefulness in learning DCN.

   Strongly disagree   Agree   Strongly agree

   ○   ○   ○   ●   ○

NetLAB : Mobile Application for learning DCN

Software Testing

1. Did you find the application helpful in learning Data Communication and Networking?

Strongly disagree		Agree		Strongly agree
○	○	○	○	⌀

2. From your opinion based on your experience in using the application, do you think that it will be able to complement the learning process, whether it is during class or not?

Strongly disagree		Agree		Strongly agree
○	○	○	○	⌀

3. Do you able to understand the basic concept of networking based on the components that were included in the application?

Strongly disagree		Agree		Strongly agree
○	○	○	⌀	○

4. Do you agree that the application will be able to complement the scarce resources in learning DCN?

Strongly disagree		Agree		Strongly agree
○	○	○	⌀	○

5. Do you agree that the application helps you to understand the practicality of DCN in real life?

Strongly disagree		Agree		Strongly agree
○	○	○	⌀	○

6. Please rate the application's overall level of usefulness in learning DCN.

Strongly disagree		Agree		Strongly agree
○	○	○	⌀	○

NetLAB : Mobile Application for learning DCN

Software Testing

1. Did you find the application helpful in learning Data Communication and Networking?

    Strongly disagree   Agree   Strongly agree
    ○   ○   ○   ○   ⊘

2. From your opinion based on your experience in using the application, do you think that it will be able to complement the learning process, whether it is during class or not?

    Strongly disagree   Agree   Strongly agree
    ○   ○   ○   ○   ⊘

3. Do you able to understand the basic concept of networking based on the components that were included in the application?

    Strongly disagree   Agree   Strongly agree
    ○   ○   ○   ⊘   ○

4. Do you agree that the application will be able to complement the scarce resources in learning DCN?

    Strongly disagree   Agree   Strongly agree
    ○   ○   ○   ⊘   ○

5. Do you agree that the application helps you to understand the practicality of DCN in real life?

    Strongly disagree   Agree   Strongly agree
    ○   ○   ○   ○   ⊘

6. Please rate the application's overall level of usefulness in learning DCN.

    Strongly disagree   Agree   Strongly agree
    ○   ○   ○   ○   ⊘

NetLAB : Mobile Application for learning DCN

Software Testing

1. Did you find the application helpful in learning Data Communication and Networking?

Strongly disagree		Agree		Strongly agree
○	○	○	●	○

2. From your opinion based on your experience in using the application, do you think that it will be able to complement the learning process, whether it is during class or not?

Strongly disagree		Agree		Strongly agree
○	○	○	●	○

3. Do you able to understand the basic concept of networking based on the components that were included in the application?

Strongly disagree		Agree		Strongly agree
○	○	●	○	○

4. Do you agree that the application will be able to complement the scarce resources in learning DCN?

Strongly disagree		Agree		Strongly agree
○	○	●	○	○

5. Do you agree that the application helps you to understand the practicality of DCN in real life?

Strongly disagree		Agree		Strongly agree
○	○	○	○	●

6. Please rate the application's overall level of usefulness in learning DCN.

Strongly disagree		Agree		Strongly agree
○	○	○	●	○