SIGNAL EQUIPMENT AUTOMATED TRAINING SYSTEM VERSION 2

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Submitted to the faculty of Department of Computer Software Engineering, Military College of Signals, National University of Sciences and Technology, in partial fulfillment for the requirements of B.E Degree in Computer Software Engineering, June 2020

In the name of ALLAH, the Most Beneficent, the Most Merciful

ABSTRACT

SIGNAL EQUIPMENT AUTOMATED TRAINING SYSTEM V2

SEATs is primarily a defense purpose project of signal directorate to digitize and automate the learning of signal equipment by using GUI based module. It will comprise of front panel of all signal communication equipments with complete hands on training without any presence of equipment/instructor. This project will not only work as a training Aid but also provide an opportunity to the defense personal as simulator. This project is GUI based application which will have various signal equipments having vast usage in a field in the form of API supported by GUI which will be very economical, user friendly and having no complication

CERTIFICATE OF CORRECTIONS & APPROVAL

Certified that work contained in this thesis titled "Signal Equipment Automated Training System Version 2", carried out by Capt Ahsan Bilal Tariq, Maj Najam, Capt Shan-e-Umar, Capt Rizwan under the supervision of Maj Khawir for partial fulfillment of Degree of Bachelors of Software Engineering, in Military College of Signals, National University of Sciences and Technology, Islamabad during the academic year 2019-2020 is correct and approved. The material that has been used from other sources it has been properly acknowledged / referred.

Approved by

Brig Dr Adnan Ahmad Khan

Supervisor

Maj Khawir

Department of CSE, MCS

Date: _____

DECLARATION

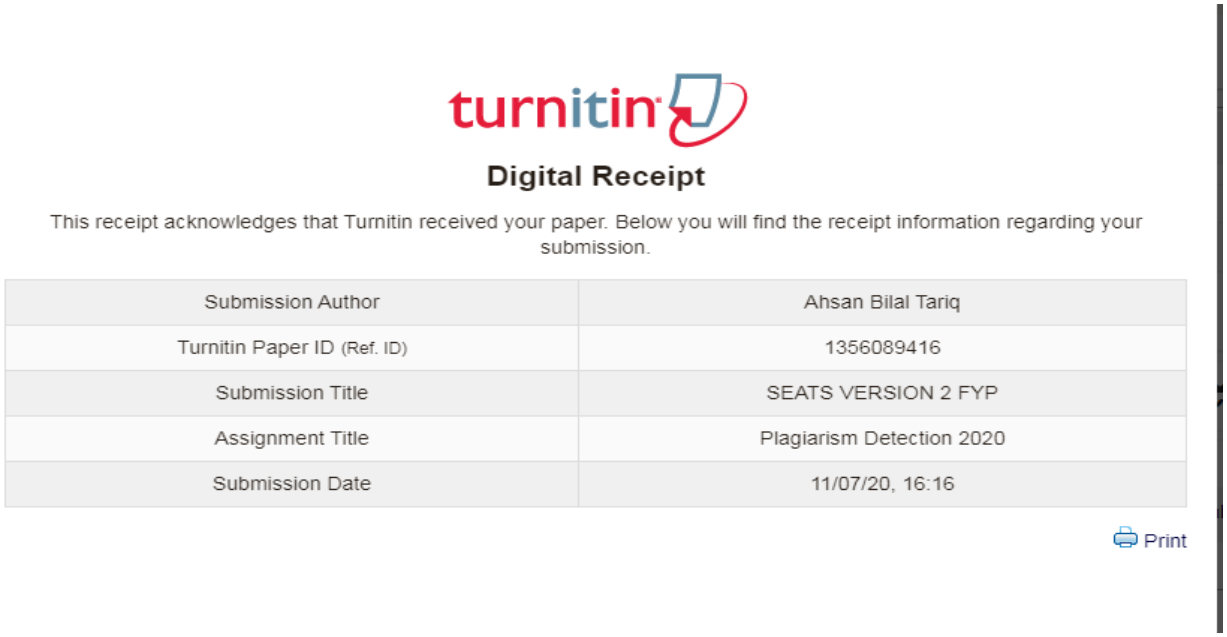
We are here by declaring that this application neither as whole nor as a part has been copied out from any source. It is further declared that we have developed this application and accompanied report entirely on the basis of our personal efforts, under the sincere guidance of our supervisor and teachers. If any part of this system is proved to be copied out from any source or found to be reproduction of someone else, we shall stand by the consequences

DEDICATION

To our parents and family members who have never failed to give us financial and moral support for giving all our needs during the time we developed our system. To our supervisor who has given us great support and valuable suggestions throughout the implementation process and finally to our respected teachers who supported us all the way

Plagiarism Certificate (Turnitin Report)

This thesis has been checked for Plagiarism. Turnitin report endorsed by Supervisor is attached



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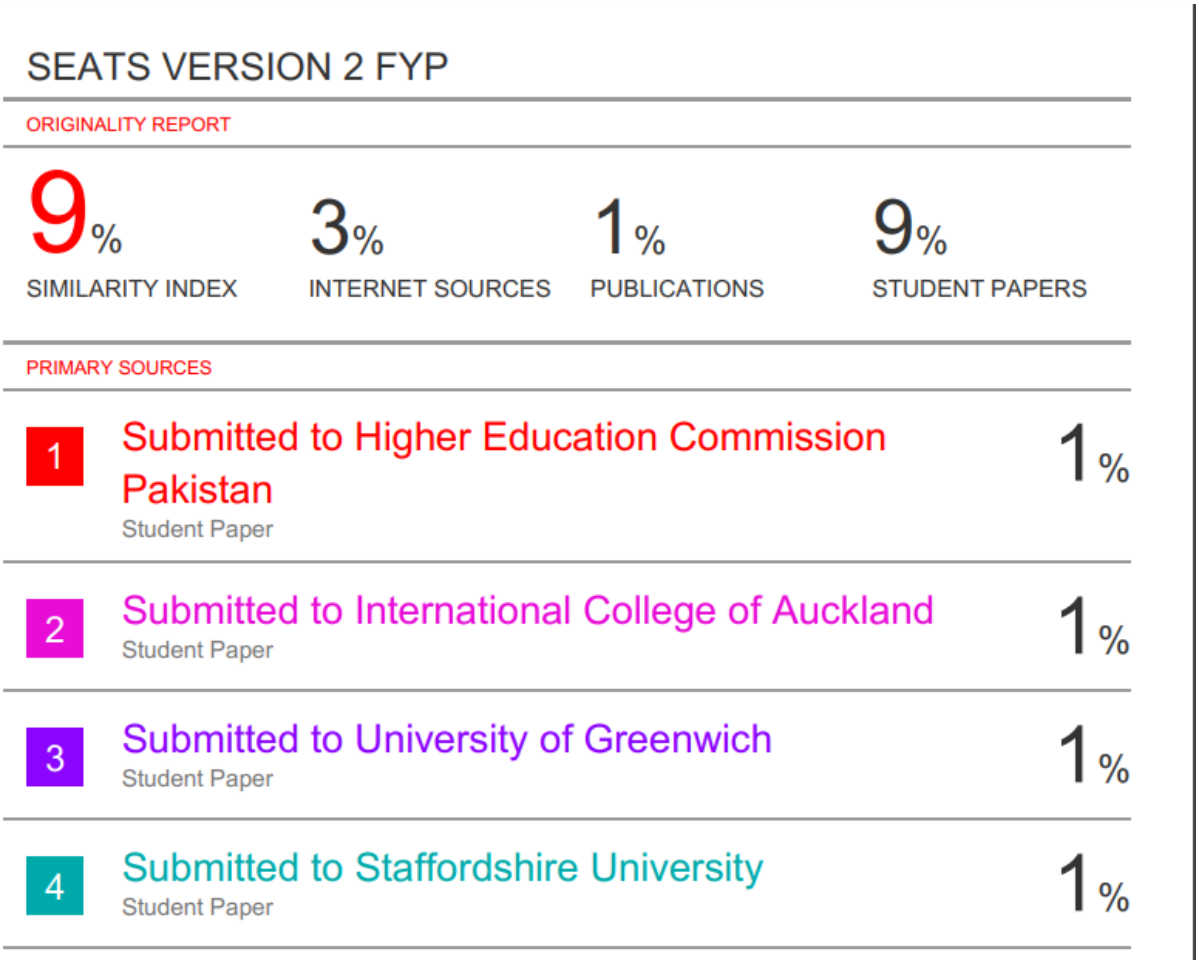

SEATS VERSION 2 FYP

ORIGINALITY REPORT

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ACKNOWLEDGEMENTS

All of our gratitude is extended to Almighty Allah, the most beneficent, whose blessings empowered us to tread this journey.

We feel indebted to the benign faculty of Department of Computer Software Engineering, who raised us to these standards of knowledge; and especially to Maj Khawir, whose unending support, motivation and guidance made us capable of turning the concept of this project into reality.

We also extend our thankfulness to our families and friends, who kept our moral spirits high in the times of need.

PREFACE

This thesis will present the detail study, design and implementation and testing of the project "Signal Equipment Automated System Version 2" For ease of scenarios we have divided it into Five chapters

Chapter One: This chapter describes the introduction, objectives and scope of system

Chapter two: The purpose of requirement analysis is to obtain requirements and information from the stakeholders and users for developing software. This chapter contains scope, objective, functional and non functional requirements of the system

Chapter Three: This chapter contains the detailed design of the application of the system and the objects in the system. The development techniques and interfaces of our system are discussed in this chapter

Chapter Four: This chapter discusses software requirement specifications in which each module describes its functionality, behavior, performances and quality by unit testing. It is concerned with the environment and deployment settings and contains all the information regarding the usage and practical manifestation of this system

Chapter Five: This chapter contains the user manual which has all the information about how to use the software

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CHAPTER #1

INTRODUCTION

1.1 Introduction

The main theme of SEATS v2 is to easily access and understand the different highly costly modules of Corps of Signals which functionality and usage are very complicated. It has to be implemented down level for practical manifestation in training institutions and at various formation level during cadres. SEATS v2 brought about many improvements in the version 2 and introduced various new sets/software.

1.2 Background of the SEATS

Previous work done includes SEATS v1. As per recommendation from various units and signals dte new Sets needed to be included foreseeing Pak Army new future operational commitments and many improvements were also needed in SEATS v1

1.3 Objectives of SEATS

Seats project is primarily be focusing on the training of soldiers to understand the concept of various signal equipment, configuration, communication and simulation. It will not only allow the soldiers to gain the knowledge of equipments but will allow them to pace with the modern technology like other modern armies in the world. It will also help soldiers to understand the concept of web based application which is otherwise very useful for the modern soldier

1.4 Significance of SEATS v2

- Finish flaws in SEATS v1
- Add new tutorials in existing sets
- Add new sets as Army and Sig dte requirements

CHAPTER #2

REQUIREMENT ANALYSIS

1.1 Introduction

SEATS version 2 is a primarily defense project of signals directorate to digitize and automate the learning of signal equipment by using GUI based module. It will compromise of front panel of signal communication equipment with complete hands on training without any presence of equipment/instructor. This project will not only work as a training aid but will also provide an opportunity to the defense personal as simulator. This project is a GUI which will have various signal equipment having vast usage in the field in the form of API supported by GUI which will be very economical, user friendly and having no complication.

1.2 Purpose

SEATS version 2 will be focusing on the training of soldiers to understand the concept of various signal equipment, configuration, communication and simulation. It will not only allow the soldiers to gain the knowledge of equipment but will allow them to pace with the modern technology like other modern armies of the world. It will also help soldiers to understand various signals equipment using GUI based applications.

1.3 Definitions, Acronyms, Abbreviations

Abbreviation	**Complete**
SEATS	Signal Equipment and Training System
MCS CSE Dept	Military College of Signals' Computer Software Engineering Department
V2	Version 2
Sigs	Signals

1.4 Document Conventions

The conventions used to prepare the document is given bellow

- Font–Times New Roman, size 12
- Main headings, Font–Times New Roman, Bold, size 18
- Sub headings, Font–Times New Roman, Bold, size 14

1.5 Intended Audience and Reading Suggestions

The Software Requirements Specification (SRS) document is meant for the following stake holders.

- **Project Supervisor:** To assist in project supervision and guiding the team in a better way.
- **Development Team:** To help in development of product and trace-back of functional requirements.
- **Testing Team:** To help the testers to understand the applicable constraints.
- **Users:** Pakistan Army Soldiers/Officers
- **UG Project Evaluation Team:** To help the evaluation board in for gauging the progress of SEATS

1.6 Project Scope

- Up gradation and improvement of SEATS v1 as per the feedback received from Army
- Addition of 4 new signals equipment which will allow GUI based training of Army soldiers and officers
- This SEATS v2 will be developed in C sharp code. This simulator will allow the user to login and enter credentials which will help SEATS v2 suit to maintain database of users

1.7 References

- SEATS version 1 documentation
- Army Signal equipment manuals
- **Use Case Modeling Guidelines**, which documents the guidelines used to develop the use case model specifying the functional requirements in this specification. http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=787548
- **System Requirements Specification Content and Format Standard**, which specifies the content and format of this specification. http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?tp=&isnumber=15571&arnumber=720574&punumber=5841
- **System Requirements Specification Template**, which provides the skeleton for this specification. http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?tp=&isnumber=16016&arnumber=741940&punumber=5982

2. Overall Description

2.1 SEATS version 2 perspective

This SEATS v2 can be useful in following perspective:

- For training in various school of instructions
- Easily accessible to all intended users which were lacking due to deficiency and highly costly equipment
- It can be helpful for maintaining the database and becoming proficient in acquiring skills on SEATS module
- Improvements in SEATS v1 as per feedback received from various formations of the Army
- Addition of new equipment

2.2 Functionalities

Following are the functional requirements:

- Design database interface
- User login and authentication for access
- Show main user interface after login
- Various sets/equipment will be available for training
- Record keeping of various users
- Test to check the proficiency of learning at the end

Following are the non functional requirements:

- Easy to understand
- System must be able to display data with all desired actions
- Password protected

2.3 Users Classes and Characteristics

- The end users of SEATS v2 are restricted to defense personal only
- Officers and soldiers of Signals and all other regiments will be able to use the system.

2.4 Operating Environment

This is a GUI based application. The software and languages used are mentioned below:

- Visual Studio
- Languages: C SHARP
- Coral draw
- Windows 10
- Adobe Photoshop

The system of SEATS version 2 shall run on the computer system with following specifications

- Pentium 4 or higher CPU
- At least 512 MB RAM

- At least 1 GB free disk space
- Windows 10

2.5 Design and Implementation Constraints

The intent of this project is to make a simulator of different signal equipment which soldiers can access while sitting in their own organizations. The design includes:

- Login page
- Basic event handlers
- Multiple event addition side by side

2.6 Developing

The most important module in this project is GUI based interface of different signals equipment which are part of this project and then subsequently adding events. This is developed using coral draw and overall prepared in visual basic

- **Key Features**
  - Can support minimum windows 10 with at least 4 GB RAM processor
  - Multiple assistance to be added like cursor, voice enabling and step by step explanation which can make users understand

2.7 User Documentation

Final release will be accompanied with an user guide to inform users how to use equipment in SEATS version 2. User documentation that would be delivered along with the final product

- User manual with instructions, pictures and text for understanding how to operate SEATS v2 equipment

2.8 Assumptions and Dependencies

- Equipment in simulator will be taken as actual signals equipment operated in the field
- It is a standalone GUI so it can operate in any independent environment
- It does not require and Wi-Fi or internet access

3 External Interface Requirements

3.1 User Interfaces

The interfaces available to the users are the main front panel after login which can be handled after taking subsequent actions. Example is shown below

Please note that the interface provided are just for demonstration purposes. Actual interfaces may be different.

3.2 Hardware Interfaces

There will be an interface drawn for each panel of equipment designed in coral draw. User of SEATS version 2 can navigate and select the desired functionalities available on the interface. Computer system hardware interfaces are as follows

- System shall have keyboard/mouse input
- System shall have a monitor

3.3 Software Interfaces

Following software will be used in this project

- Visual studio
- SQL
- Adobe Photoshop
- Macromedia director
- Coral draw
- Adobe after effects

4 SEATS version 2 Features

Version 2 of SEATS is based on two main modules. First module comprises of improving some functionalities of SEATS v1 as per feedback received from different formations. The improvements required for different equipment of SEATS version 1 are as under:

1) **HARRIS (5800/7800)**

    1) Urdu language doesn't work in some tutorials which has to be corrected

2) More details in few tutorials may be provided

2) SDR-9661

1) One button in the date and time tutorial is not working correctly

3) NGPATCOMS

1) All radio ports should be red before synch

2) PCU (Power control unit) sub menu does not exist in SEATS version 1

3) When a lower level menu is closed the application should go to its parent view instead of shutting down

4) In manual alignment of PCU, the software does not cater for elevation changes

5) Save option does not appear after any change in configuration

4) M3TR

1) Add more details in functionality in some functions and correct some tutorials

Second module is based on addition of new equipment which will be integrated with SEATS v1. The equipment to be added is:

1) HARRIS-7800H WMT

2) TNAC-6010

3) LMR NMS

4) IP Nera

4.1 Sub SEATS version 2 Features

- After authentication the users are required to select any equipment of the given and then follow the subsequent learning parameter which will be assisted by voice command and instruction indication by cursor. These are the real time commands exercised over these equipment and thus they help soldiers to attain proficiency required to have full command over the equipment.

- Since it is GUI based so it does not depend on any external communication channel like WIFI, so once it is downloaded, it will be functional.

4.2 Login to SEATS

Description

This feature enables the system to acquire video from the user who will upload it into the application. This video will be fed into the system for further processing.

Stimulus/Response Sequences

Normal Path: Login Successful
Preconditions • The user provides his login credentials for login purpose
Interactions • The login details are sent to the system/database for processing
Post conditions • Successful Login Message displayed.
Categorization • **Criticality**: High • **Probability of Defects**: Medium • **Risk**: High

Exceptional Path: Error Message Displayed
Preconditions • Invalid Login details
Interactions An error message is displayed telling the user that login failed
Post conditions • Login failure message displayed
Categorization • **Criticality**: High • **Probability of Defects**: Medium • **Risk**: High

Functional Requirement

The system shall be able to check login details of user, match them with the database for processing and authentication.

4.3 Select Equipment

Description

This feature involves selecting the equipment for training purpose

Stimulus/Request Sequences

Normal Path: Equipment Selected
Preconditions • The user selects the equipment using cursor.
Post conditions • The equipment gets selected moving to the new window.
Categorization • **Criticality**: Medium • **Probability of Defects**: Medium • **Risk**: Medium

Functional Requirement

System shall be able to effectively process the selected equipment and move to the next equipment.

4.4 Start Tutorials

Description

Tutorials will be started for the selected equipment

Stimulus/Response Sequence

Normal Path: Tutorial started
Preconditions • Clicking on start tutorial using cursor
Interactions • Selection
Post conditions • Tutorial starts
Categorization • **Criticality**: High • **Probability of Defects**: High • **Risk**: High

Exceptional Path: Tutorial does not start
Preconditions • Clicking on start tutorial using cursor
Interactions • Selection of start tutorial tab.
Post conditions • Tutorial does not start
Categorization • **Criticality**: High • **Probability of Defects**: Low • **Risk**: High

Functional Requirements

System shall be able to start the tutorials for the equipment

5 Other Non Functional Requirements

5.1 Performance Requirements

- User must have PC available
- Windows 7 and above

5.2 Safety and Security Requirements

- This is a defense related project so security is a important consideration to cater for
- SEATS version 2 simulator is required to be shared with the organization who should have their own security mechanisms to avoid any unauthorized access to the system

5.3 Software Quality Attribute

- SEATS version 2 equipment is easy to use
- It is easy to understand

- It must have an attractive user interface. Usability is an important criterion in the development of SEATS version 2. The system should present all functionalities in such a way that nothing is missed by the user. The graphical user interface of the equipments is to be designed with usability as the first priority. The equipment will be presented and organized in a manner that is both visually appealing and easy for the users to navigate

6. UML DIAGRAMS

- Basic Flow diagram of SEATS v2 is attached in Appendix A

- Use Case diagram is attached in Appendix B

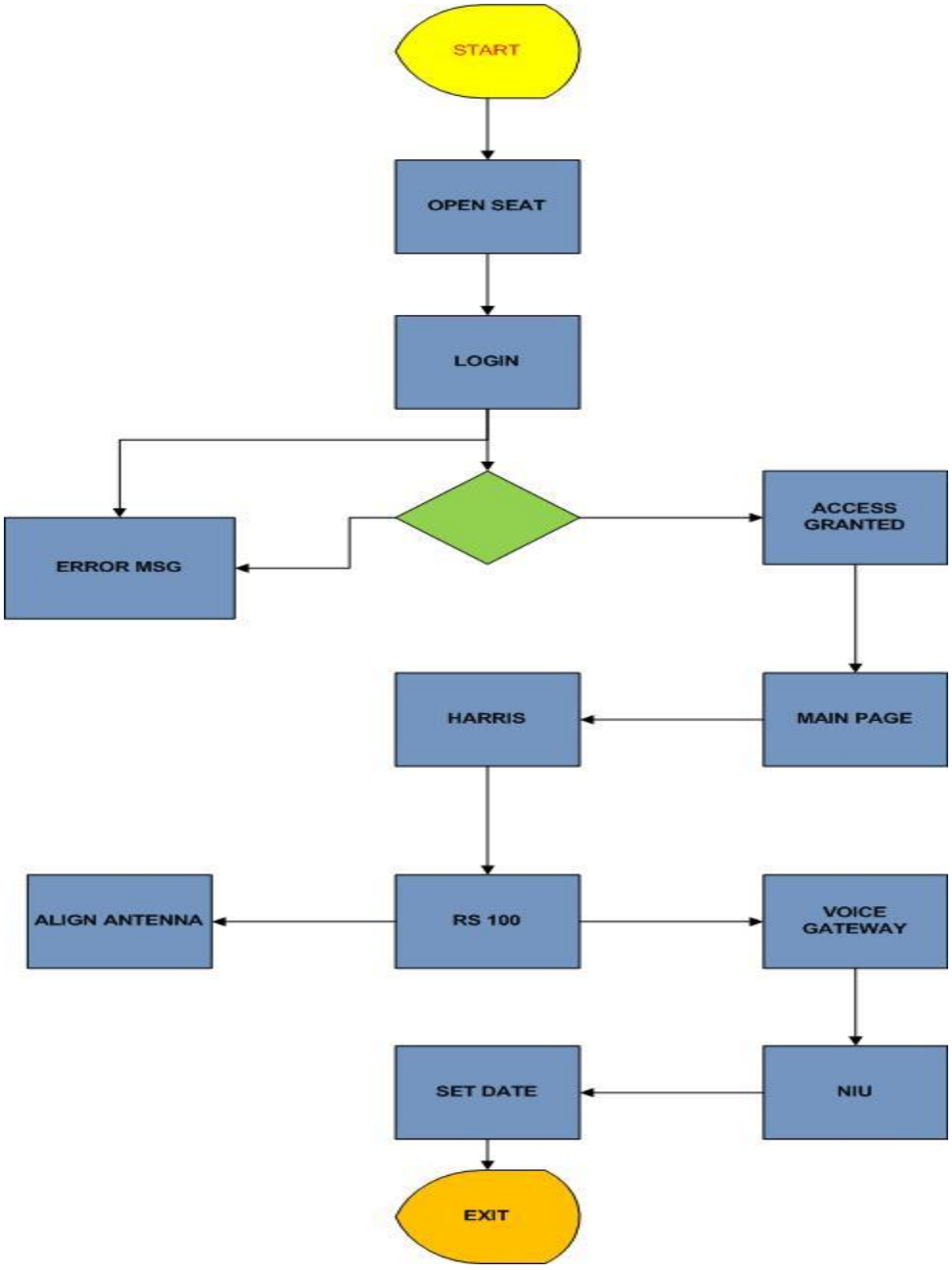
Use Case ID:	1		
Use Case Name:	On/Off		
Actors:	Users		
Created By:	Ahsan Bilal	**Last Updated By:**	Group Members
Date Created:	30-10-2019	**Date Last Updated:**	30-10-2019
Description:	Actor opens the on/off for Harris Equipment		
Preconditions:	The actor has to open the SEATS on PC		
Post conditions:	If the use case is successful the actor will be able to on and off, otherwise state remains unchanged		
Normal Flow (primary scenario):	The use case starts when the actor opens SEATS		

7. Bibliography

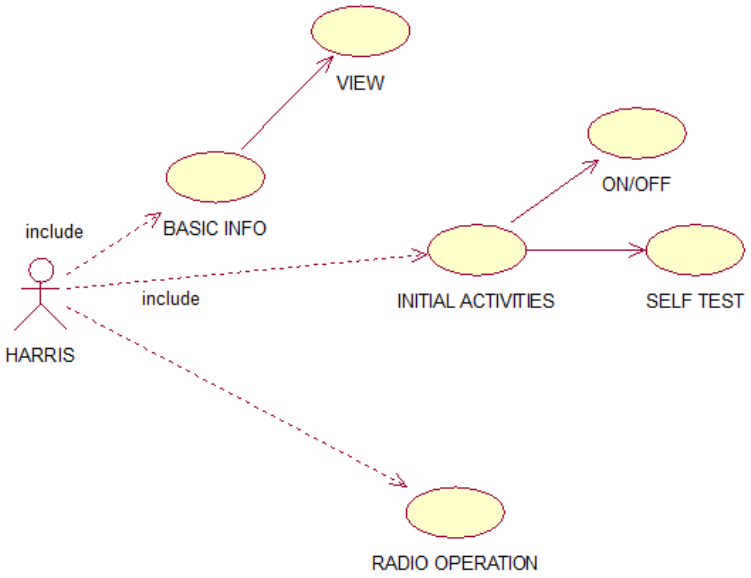
- Software Requirements (4th edition) (Developer Best practices)by Karl Wiegers

- Existing systems : SEATS version 1

Appendix A: Flow Diagram



Appendix B: Use Case Diagram



Appendix C: Project Proposal

SEATS V2 PROJECT PROPOSAL

1.1 Brief Description of Project

SEATS v2 is primarily a defense purpose project of signal directorate to digitize and automate the learning of signal equipment by using GUI based module. It will comprise of front panel of all signal communication equipments with complete hands on training without any presence of equipment/instructor. This project will not only work as a training Aid but also provide an opportunity to the defense personal as a simulator. This project is web based application which will have various signal equipments having vast usage in a field in the form of API supported by GUI which will be very economical, user friendly and having no complication.

1.2 Scope of work

It is a defense offered project related to the field of communication with various signal equipment. Scopes of seats are:-

a. Will be used as a training aid in signal units and training institutions.
b. Not only act as training aid but work like Training simulator.
c. Covers the details of various radio communication aspects.
d. Various signal equipment application.
e. Digital configuration
f. Will have extensive usage in the field being user friendly.

1.3 SEATS V2 Scope

Make new modules of equipment to facilitate training of soldiers and officers in Pak Army. Following equipment will be analysed and feasible equipment will be added as new modules: -

- Harris-7800H WMT
- TNAC-6010
- LMR NMS
- IP NERA

Furthermore improvements will be made in existing SEATS version 1 as per feedback received from different formations of Pakistan Army

1.4 Academic Objective

Seats project is primarily be focusing on the training of soldiers to understand the concept of various signal equipment, configuration, communication and simulation. It will not only allow the soldiers to gain the knowledge of equipments but will allow them to pace with the modern technology like other modern armies in the world. It will also help soldiers to understand the concept of web based application which is otherwise very useful for the modern soldier.

1.5 End Goal

End goal objective is to create such web based application which should be user friendly easy to understand and comprising of all those necessary signal equipments which soldiers need to handle practically on ground without any difficulty. As these equipment maintenance, handling is a demanding job and having limited quantity being costly is also a big challenge in a way of learning hence this application will provide a ultimate platform for overcoming all these challenges.

1.6 Previous work done

- SEATS V1

1.7 Number of Students Required

4 x students are required for this project to complete in a given timeline.
Details of students are as under:-

a. Capt Ahsan Bilal Tariq (BESE22-A) CGPA 3.98
b. Capt Shan-e-Umar (BESE 22A)
c. Capt Najam-ul-Hassan (BESE 22A)

d. Capt Rizwan Khan (BESE 22A)

1.7 Material or Sources Required

Following sources will be required as an aid for the project:-

a. Visual studio
b. SQL
c. Adobe captive
d. Adobe Photoshop
e. Macromedia director
f. Coral draw
g. Signal equipment user manual

1.8 Special skills required

Since SEATS is military based application so it will be requiring first hand military background knowledge about all the incorporated signal equipments that includes frequency hopping, communication principles, simulation and their various features

CHAPTER #3

SEATS v2 DESIGN

1 Introduction

1.1 Introduction

This design document captures all functional requirements and shows how they interact with each other conceptually. The low level design also shows as to how we have been implementing these requirements. The document is intended to inform stakeholders of the details of the design and the design process. This document will help the developer in implementation and making functionalities more smoothly to understand.

1.2 Definitions, Acronyms and Abbreviations

SEATS v2	Signal Equipment Automated Training System version 2
App	Application
Sml	Simulator
UML	Unified modeling language
GUI	Graphical user interface
HARRIS	One of the communication set integrated in Simulator
TNAH 6010	One of the communication set integrated in Simulator
LMR NMS	One of the communication set integrated in Simulator
IP NERA	One of the communication set integrated in Simulator

1.3 Purpose

The purpose of this Software Design Document is to provide a description of the design of system fully enough to allow for software development to proceed with an understanding of what is to be built and how it is expected to be built. This Software Design Document provides information necessary to get a description of the details for the software and the system to be built. The purpose of this document is to present a design view and detailed description of the SEATS v2. It will explain the purpose and features of the system, the interfaces of the system, what the system will do, its entire processes in detail, the constraints under which it must operate and how the system will react to inputs and what will be its outputs. This document is intended primarily for the stakeholders and the developers of the system.

1.4 Document Conventions

Document Text	Font-Times New Roman	Size-12pt	Not bold
Level 1 Main Headings	Font-Times New Roman	Size-18pt	Bold
Level 2 Headings	Font-Times New Roman	Size-16pt	Bold
Level 3 Headings	Font-Times New Roman	Size-14pt	Bold
Level 4 Headings	Font-Times New Roman	Size-12pt	Bold
Level 5 Headings	Font-Times New Roman	Size-12pt	Bold

1.5 Intended Audience and Reading Suggestions

The Software Design Specification (SDS) document is meant for the following stake holders.

- **Project Supervisor:** To assist in project supervision and guiding the team in a better way.
- **Development Team:** To help in development of product and trace-back of functional requirements.
- **Testing Team:** To help the testers to understand the applicable constraints.
- **Users:** The potential stakeholders of the system, including the users and Telecommunication Providers.
- **UG Project Evaluation Team:** To assist the evaluation committee in evaluation progress of UG Projects.

1.6 Project Scope

The Scope of project is firstly to improve some functions in SEATS v1 as per feedback received from the Army and then secondly to understand the functionalities of different simulators which are being added in

SEATS v2. Further it will be then converted to GUI based application having same external surface as SEATS v1 and to act like a real Signal simulator. It will be manually operated by the users for every intended functions. All functionalities of simulators will be tagged and will be displayed on the front panel and user can easily choose the desired actions installed in data base.

1.7 References and Acknowledgments

- 2014, Software Engineering Standards Committee of the IEEE Computer Society, "IEEE Recommended Practice for Software Design Descriptions", IEEE Std 1016-1998.
- Applying UML and Design Patterns - An Introduction to Object-Oriented Analysis and Design (Craig Larman)" available from:
- http://www.ebookdirectory.com/
- UML basics: An introduction to the Unified Modeling Language (Donald Bell) " available from:
- http://www.ebookdirectory.com/
- UML Distilled: A Brief Guide to the Standard Object Modeling Language by Martin Fowler" available from:
- http://www.ebookdirectory.com/
- Learning UML 2.0 by Russ Miles" available from:
- https://www.scribd.com/
- The Unified Modeling Language User Guide by Grady Booch " available from:
- https://www.scribd.com/
- https://books.google.com/?hl=en
- www.w3schools.com

2.0 System Overview

2.1 SEATS version 2 perspective

The Software Design document (SDD) will focus on specifying a high-level view of the architecture of our system and on the interaction between the user and the system and will focus on detailing a low-level view of each component of the software and how the components interact with each other. This document's purpose is to provide a high-level design framework around which to build our project for our specific users. It also provides a list of requirements against which to test the final project and determine whether we were able to successfully implement the system according to design. The System architecture description section is the main focus of this

document. It provides an overview of the system's major components and architecture, as well as specifications on the interaction between the system and the user. The Detailed description of components section will describe lower-level classes, components, and functions, as well as the interaction between these internal components. The Pseudo code section will provide pseudo code in order to clarify the intended operation of certain components.

2.2 System Architecture Description

In this section, the overall architecture of the system is discussed, including the introduction of various components and subsystems. It is mainly supported by system Architecture diagram which shows an insider’s perspective of the system by describing the high level software components that perform the major functions to make the system operational.

2.3 Structure and relationships

This section ponders upon the interrelationships and dependencies among various components. It is mainly described by a diagram which is further augmented by explanatory text. UML Class diagram also helps us understanding the system structure.

2.4 UML Class diagram

UML Class diagram further manifests the description of low level components of the software that include data storage and state details, thus making the system adequately comprehensible.

2.5 User Interface Issues

This section presents the main principles of the product's user interface. Not touching about the technical details, the section is described by an overall diagram which is also augmented by explanatory text. Moreover, Activity diagrams, Sequence diagrams, and UI Design diagrams also elaborate the User Interface issues in a more intelligible manner.

2.5.1 Activity diagrams

Activity Diagrams follow a workflow-based approach to describe the overall functioning of the system. They are a very good means to see how various steps are involved in major tasks inside a system using a flow chart pattern without getting into the technical details.

2.5.2 Sequence diagrams

Sequence diagrams show how different objects are involved in the completion of a functionality of the system. They have a unique format that allows the reader to see how many objects are used vis-à-vis their duration; for the completion of a system requirement.

2.5.3 UI Design

Some snapshots of graphical user interfaces are shown in this section that prototype the way a user shall be interacting with the system

2.6 Detailed description of components

This section contains detailed description of all the major components of the system in a structured pattern (table), comprising of 10 x rows. The pattern (table) maintains symmetry in the document structure; and therefore it is followed for each of the components. Each part/row of the table is identified by a *label*, explaining the purpose of each point. The description of each point vis-à-vis the component being discussed, ponders upon the detailed account of it in the system.

2.7 Reusability and relationships to other products

This section focuses upon the Reusability aspects of the various components of the system. Since the project in hand is not entirely new and does involve carrying out enhancement work in the already existing system (SEATS v1), so Reusability is a recommended strategy to be employed while organizing various system components.

2.8 Design decisions and tradeoffs

This section highlights various design decisions and the ideas behind those. It enables the reader to understand the important crux of the design that is being used while excavating a bit more about the motivations behind those decisions.

3.0 System Architecture

In this section, the overall architecture of the system is discussed, including the introduction of various components and subsystems. It is mainly supported by system Architecture diagram which shows an insider's perspective of the system by describing the high level software components that perform the major functions to make the system operational. Purpose of SEATS v2 project is primarily focusing on the training of soldiers to understand the concept of various signal equipment, configuration, communication and simulation. It will

not only allow the soldiers to gain the knowledge of equipment but will allow them to pace with the modern technology like other modern armies in the world. It will also help soldiers to understand the concept of GUI based application which is otherwise very useful for the modern soldier.

3.1.1 Overview of the modules

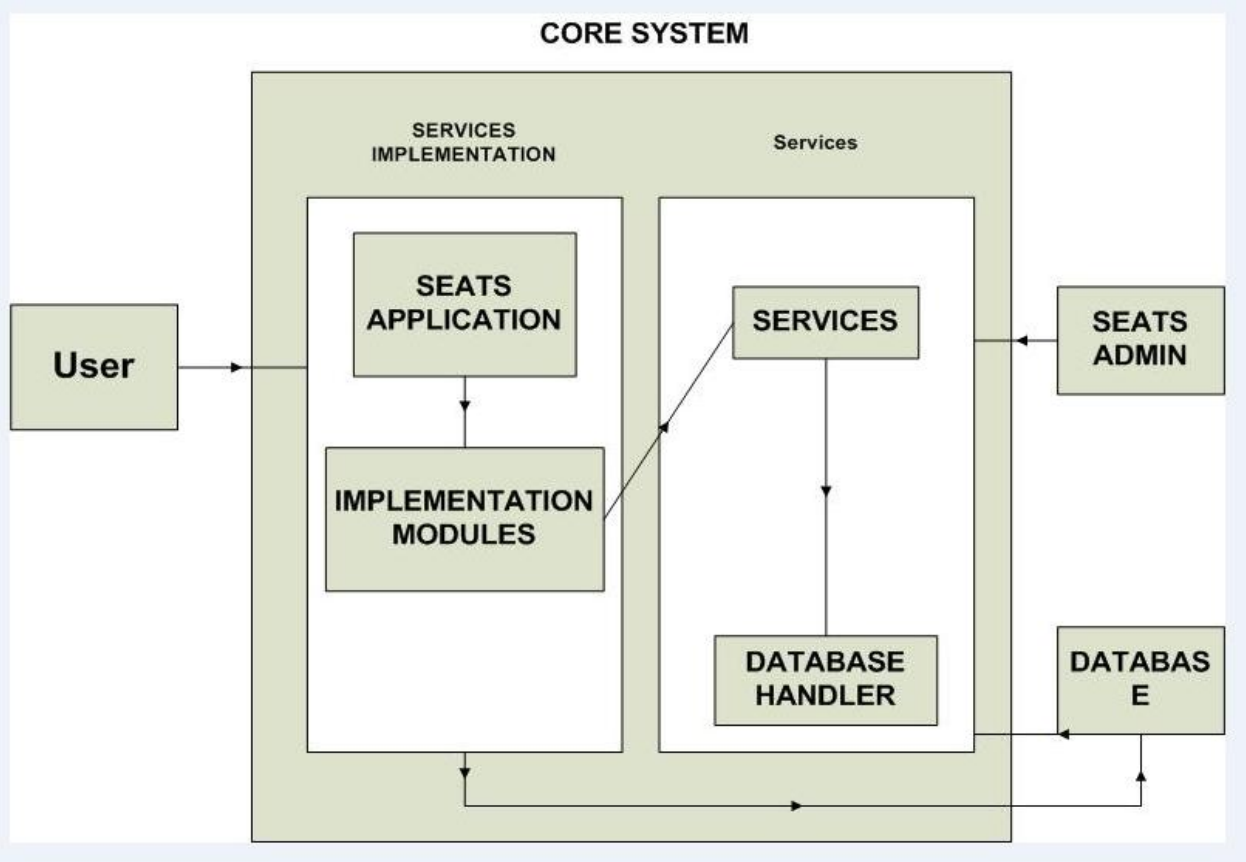


Figure 1 - Abstract Diagram

3.1.1 Explanation of Abstract Diagram

The system will be architected mainly in four fundamental modules "Users", "Core system", "SEATS Administration", and the "Database". It will further be having sub modules as shown in the abstract diagram above. Abstract diagram provides an overview of the system, from users accessing the system till the processing in databases. The sub modules of the Abstract diagram are further elaborated below.

3.1.1.1 Users

Users of SEATS will access the system and then choose functionality according to the requirement. User interacts with the app that further accesses the services provided by the app.

3.1.1.2 SEATS Application

SEATS app is the platform to access the system and provides various functionalities like training on different sets, equipment, taking tests etc.

3.1.1.3 Implementation Modules

It consists of the modules that will be responsible for all the processes in the system.

3.1.1.4 Services

These are the functionalities provided by the SEATS like tutorials and tests for various sets/equipment.

3.1.1.5 Administration

SEATS Administration interacts with the user interface for managing user accounts, dealing with the whole functionality of the system by handling all the provided services by SEATS.

3.1.1.6 Database Handler

Database handler provides a connection between the services (that are displayed on the interface) and the databases where all the data of users, sets etc regarding provided services is stored. Database hander basically handles inputs and outputs of some action that needs database access. It's a gateway to the actual databases

3.1.1.7 Database

A database stores all the data about the SEATS application, user accounts etc and all the related processing happens there.

3.2 Structure and Relationships

Layered architecture will be used with each layer providing a set of functionalities. These layers will be composed of multiple services which will communicate with each other via message passing. Conceptually, the services can be seen as components of the overall solution. However, internally, each service is made up of software components, just like any other application and these components can make use of each other without being aware of the internal implementation.

3.2.1 Layers Details

3.2.1.1 Presentation Layer

It provides a platform for the interaction of the user with the system. It displays data to the user and accepts input from the user. The Presentation layer can only receive requests from, and return responses to, an outside agent. This is usually a person, but may be another piece of software. The Presentation layer can only receive requests from, and return responses to the Business logic layer. It cannot have direct access to Data Access layer after successful login.

3.2.1.2 Business Logic Layer

When an application must provide services to other applications, as well as implementing features to support clients directly, a common approach is to use a service layer that exposes the business functionality of the application. The services layer effectively provides an alternative view that allows clients to use a different channel to access the application.

3.2.1.3 Data Access Layer

This layer receives request from the Service Layer and sends back data after querying it from the database server

3.2.2 Architecture Diagram

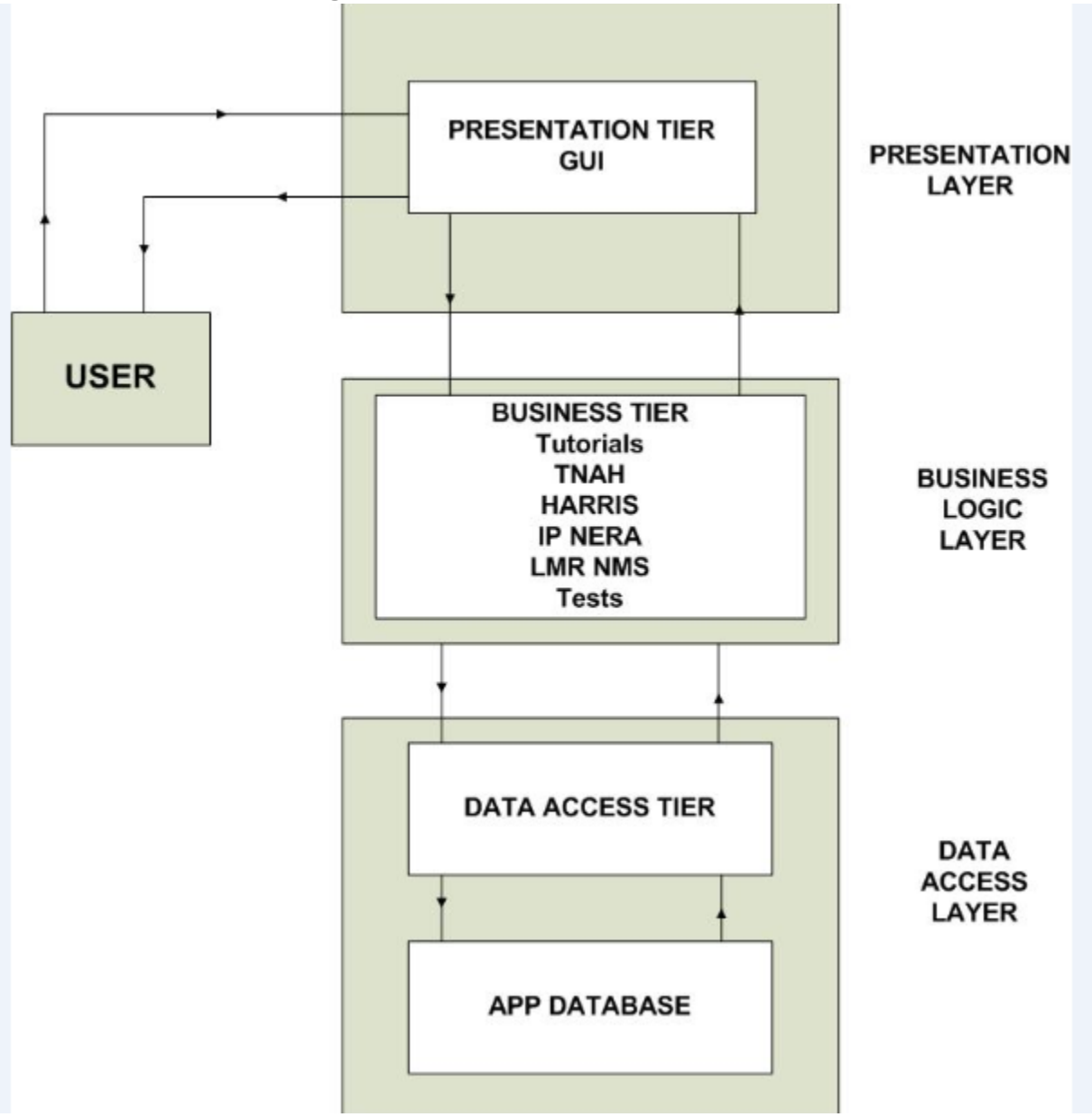


Figure 2 – Layered Architecture Diagram

Once a user opens the application, he is asked to provide username and password. This username and password are matched from a user database managed by SEATS administrators. After user successfully logs in the system, he is granted access to tutorials of all the sets integrated in the system. These features access their data from a central database. This database will be managed by the SEATS administrator

3.2.3 Use Cases

Use cases describe the Actors of the system and their actions. It gives the overview about how the factors outside the system interact and what actions they perform on the system. The various user classes identified the following use cases and primary actors for the system:

Actors	Use Cases
User	• Login • Tutorial • Test
(TNAH-6010) User	• On/Off • Self Test • Toggle Squelch • Frequency Enter • Hop Mode • Scan Channel • Fixed Scan Mode • Citadel Encryption
(HARRIS RF 7800H) User	• On/Off • Self Test • Toggle Squelch • Frequency Enter • Hop Mode • Scan Channel • Fixed Scan Mode • Citadel Encryption • Radio Lock • Zeriose

	• ALE

Actors	**Use Cases**
LMR NMS User	• Radio Lock • Fix Radio Channel • Select channel • On/Off • Self Test • Toggle Squelch • Frequency Enter • Hop Mode • Scan Channel • Fixed Scan Mode • Citadel Encryption
(IP NERA) User	• View • On/Off • Equipment Functioning • External Equipment

The aforementioned use cases can be represented in the form of the following Use Case Diagrams

3.2.3.2 Use Case Diagrams for SEATS access

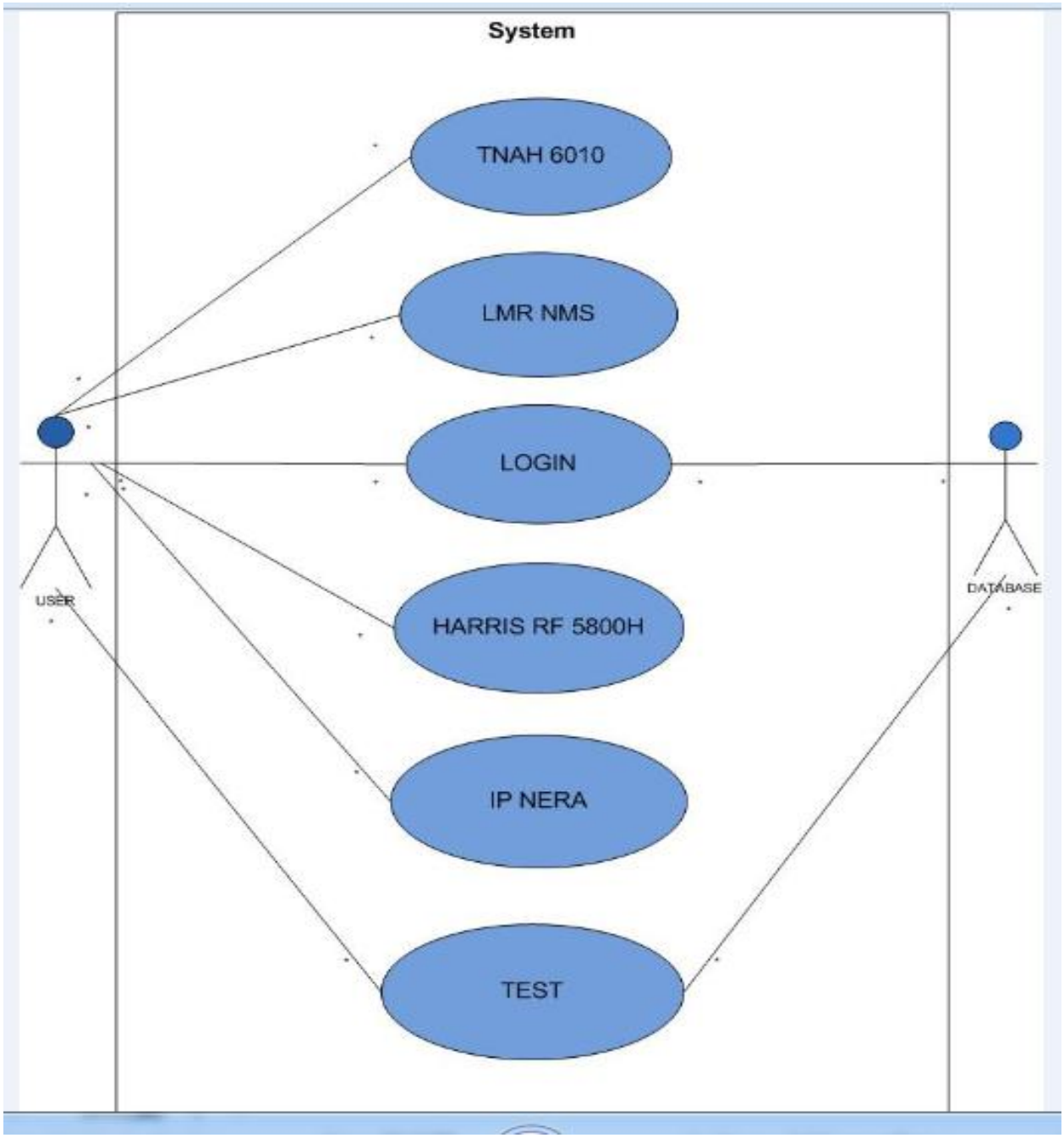


Figure 3.1 - Use Case Diagram SEATS

3.2.3.2.1 Use Case Description

- **Login**

Use Case ID:	1		
Use Case Name:	Login		
Actors:	User		
Created By:	Bilal	Last Updated By:	Bilal
Date Created:	17/12/2019	Date Last Updated:	20/12/2019
Description:	A user tries to login to the system.		
Preconditions:	The user has to start the application and open the login page first.		
Post conditions:	If the use case was successful, the user is now logged into the system. If not the system state remains unchanged.		
Normal Flow (primary scenario):	1. The system requests that the actor enter his/her name and password. 2. The actor enters his/her name and password. 3. The system validates the entered name and password and logs the actor into the system.		
Alternative Flows:	If the actor enters an invalid name and/or password, the system displays an error message. The user remains on the login page.		

- **Test**

Use Case ID:	2		
Use Case Name:	Test		
Actors:	User		
Created By:	Bilal	Last Updated By:	Bilal
Date Created:	17/12/2019	Date Last Updated:	20/12/2019
Description:	A user accesses the test functionality for various equipment.		
Preconditions:	The user has to start the application and open the login page first.		
Post conditions:	If the use case was successful, the user will be forwarded to the next window where test of equipment will begin		
Normal Flow (primary scenario):	1. The user selects test functionality 2. User is forwarded to next window		

3.2.3.2 Use Case Diagrams for TNAH-6010

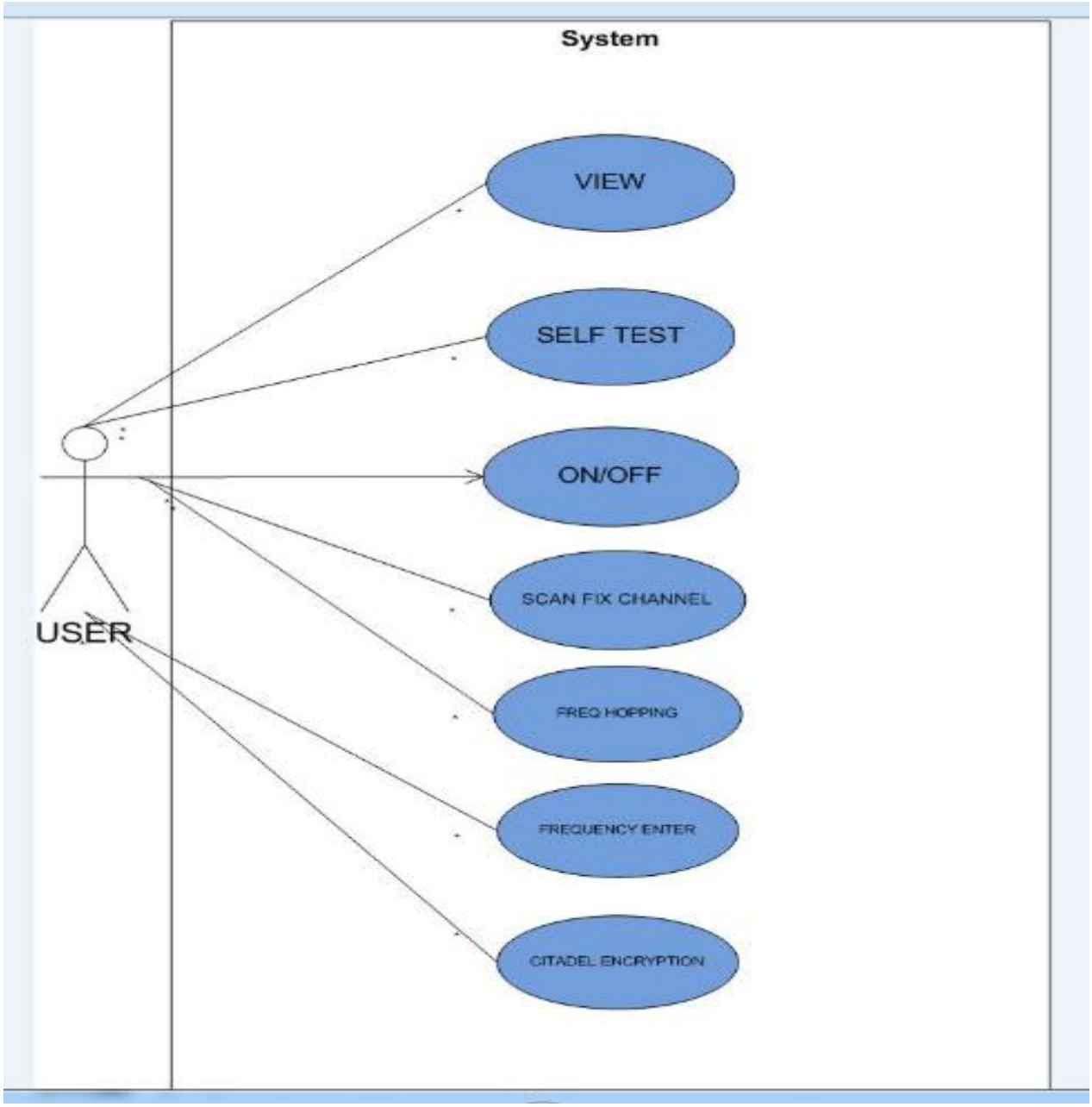


Figure 3.2 - Use Case Diagram TNAH 6010

3.2.3.2.1 Use Case Description

- **On/Off**

Use Case ID	1		
Use Case Name	On/off		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Turning the Radio set On and Off		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial simulating the functionality for turning the radio set ON and OFF will succesfully run		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens application. • He then selects functionality for turning the radio set ON/OFF • Tutorial begins explaining with Visuals, text and audio about how turn the radio set ON/OFF		

- **Self test**

Use Case ID	2		
Use Case Name	Self Test		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Starting Self Test functionality for the set		
Pre-Conditions	The actor has to open the application on PC and login		

Post-Conditions	If the use case is successful the tutorial simulating the functionality for performing self test for the radio set will begin
Normal Flow(Primary Scenario)	• The use case starts when an actor opens application. • He then selects functionality for performing self test • Tutorial begins explaining with Visuals and text about how to perform the self test and what can be the results

- **Toggle Squeltch**

Use Case ID	3		
Use Case Name	Toggle Squeltch		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Performing toggle squeltch operation		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial simulating the functionality for performing toggle squeltch operation will begin		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens application. • He then selects functionality for performing toggle squelch operation • Tutorial begins explaining with Visuals, text and audio about how to perform this toggle squelch and what are the results		

Citadel Encryption

Use Case ID	4
Use Case Name	Citadel Encryption
Actors	User

Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Turning Encryption feature ON or OFF and selecting encryption available		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial simulating the functionality for selecting encryption feature will be run		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens application. • He then selects functionality for citadel encryption • Tutorial begins explaining with Visuals, text and audio about how turn ON the encryption feature and select one option		

- **Frequency Enter**

Use Case ID	5		
Use Case Name	Frequency Enter		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Manually entering frequency for the radio set		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial simulating the functionality for manually entering the frequency will begin		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens application. • He then selects functionality for manually entering the frequency • Tutorial begins explaining with Visuals, text and audio about how to enter the frequency, the ranges available etc		

- **Hop mode**

Use Case ID	6		
Use Case Name	Hop Mode		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Selecting the hop mode		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial simulating the functionality for selecting the hop mode will begin		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens application. • He then selects functionality for selecting the hop mode • Tutorial begins explaining with Visuals, text and audio about how to select the hop mode		

- **Scan for channel**

Use Case ID	7		
Use Case Name	Scan for Channel		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Scan for available channels for coomunication		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial simulating the functionality for scanning for available channels will begin		

Normal Flow(Primary Scenario)	• The use case starts when an actor opens application. • He then selects functionality for scanning for available channels • Tutorial begins explaining with Visuals, text and audio about how to scan for the channels available

3.2.3.3 Use Case Diagrams for HARRIS RF 7800H

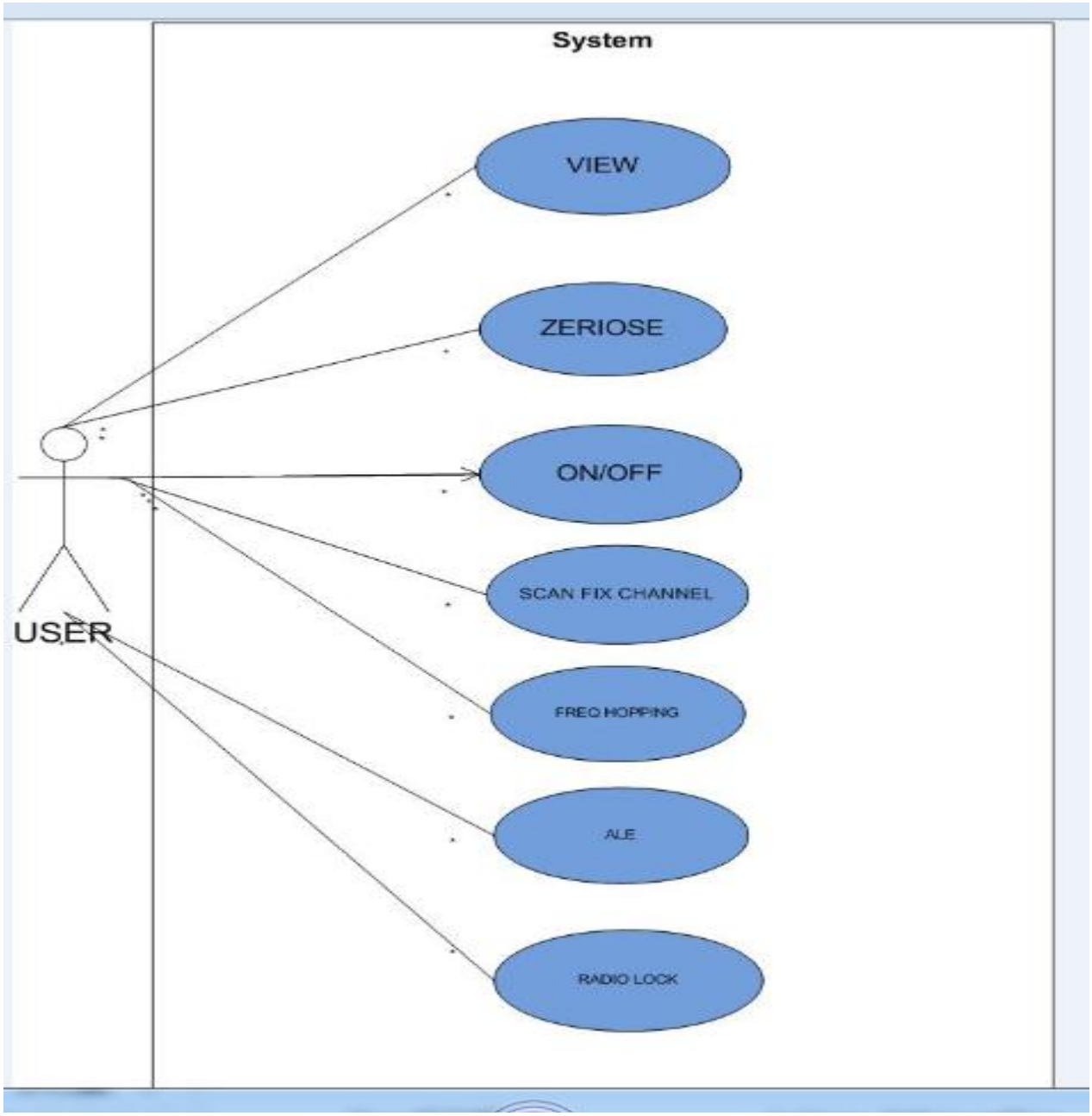


Figure 3.3 - Use Case Diagram HARRIS RF 7800H

3.2.3.3.1 Use Case Description

Use cases description for some use cases is same as use cases for TNAH 6010. Repition is omitted here

Radio Lock

Use Case ID	1		
Use Case Name	Radio Lock		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Locking the Radio		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial will begin explaining with how to lock the radio set		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for locking the radio set. • This functionality is explained with the help of visuals, written text and audio		

Zeriose

Use Case ID	2		
Use Case Name	Zerioise		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Clear all programming of radio set		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial will begin explaining with how to		

	zeriose the radio set
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for zeriosing • This functionality is explained with the help of visuals, written text and audio

ALE (Automatic Link Establishment)

Use Case ID	3		
Use Case Name	ALE		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Performing ALE		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial will begin explaining with how to perform automatic link establishment		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for ALE • This functionality is explained with the help of visuals, written text and audio		

3.2.3.4 Use Case Diagrams for LMR NMS

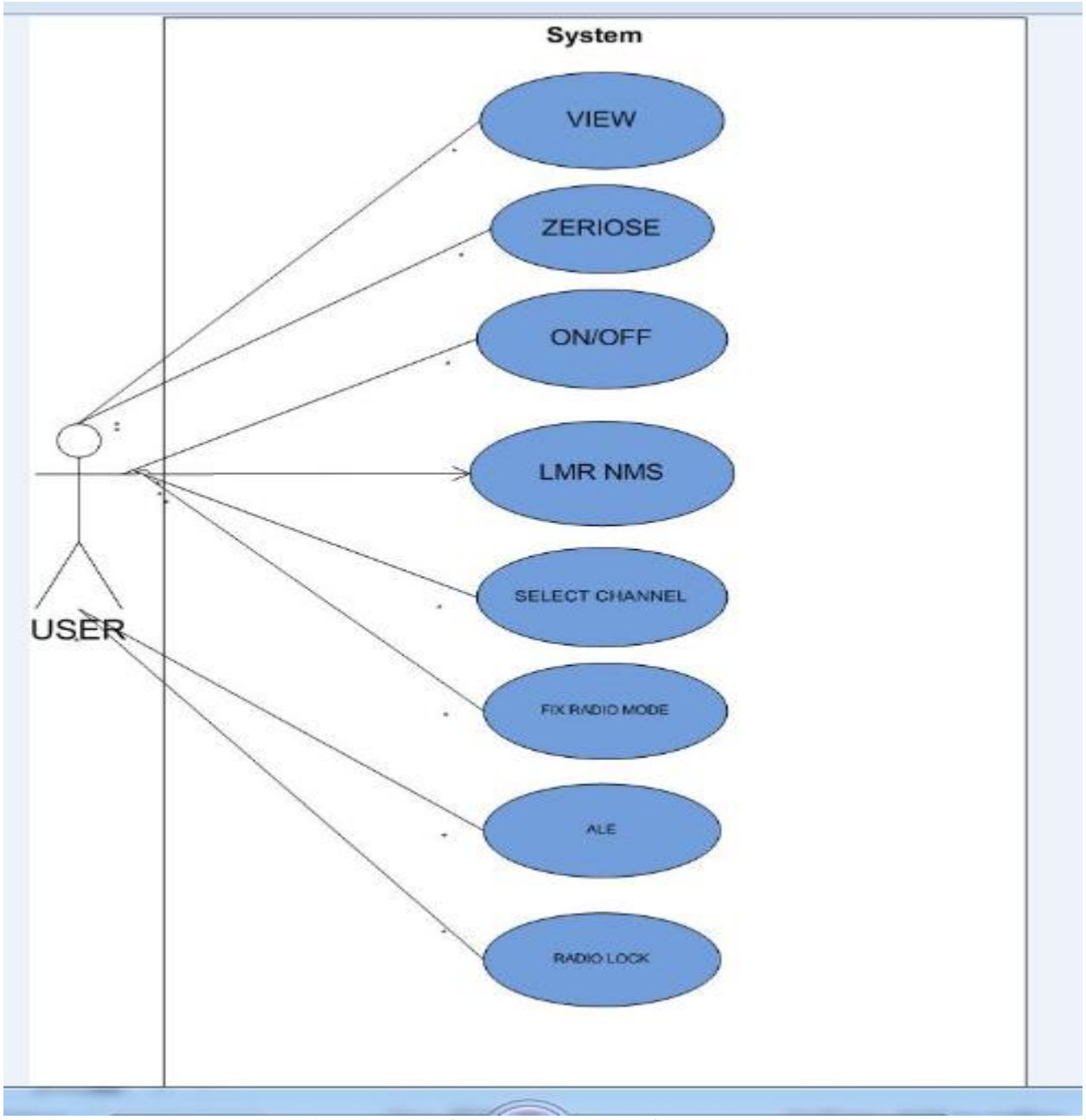


Figure 3.4 - Use Case Diagram LMR NMS

3.2.3.4.1 Use Case Description

Use cases description for some use cases is same as use cases for TNAH 6010. Repetition is omitted here

- **Fixed Radio Mode**

Use Case ID	1		
Use Case Name	Fixed Radio Mode		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Selecting Fixed radio Mode		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial will begin explaining how to select fix radio mode		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for selecting fixed radio mode • This functionality is explained with the help of visuals, written text and audio		

- **Select Channel**

Use Case ID	2		
Use Case Name	Select Channel		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019

Description	Select Channel or transmission
Pre-Conditions	The actor has to open the application on PC and login
Post-Conditions	If the use case is successful the tutorial will begin explaining how to select channel for transmission
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for selecting the channel for transmission • This functionality is explained with the help of visuals, written text and audio

3.2.3.5 Use Case Diagrams for IP NERA

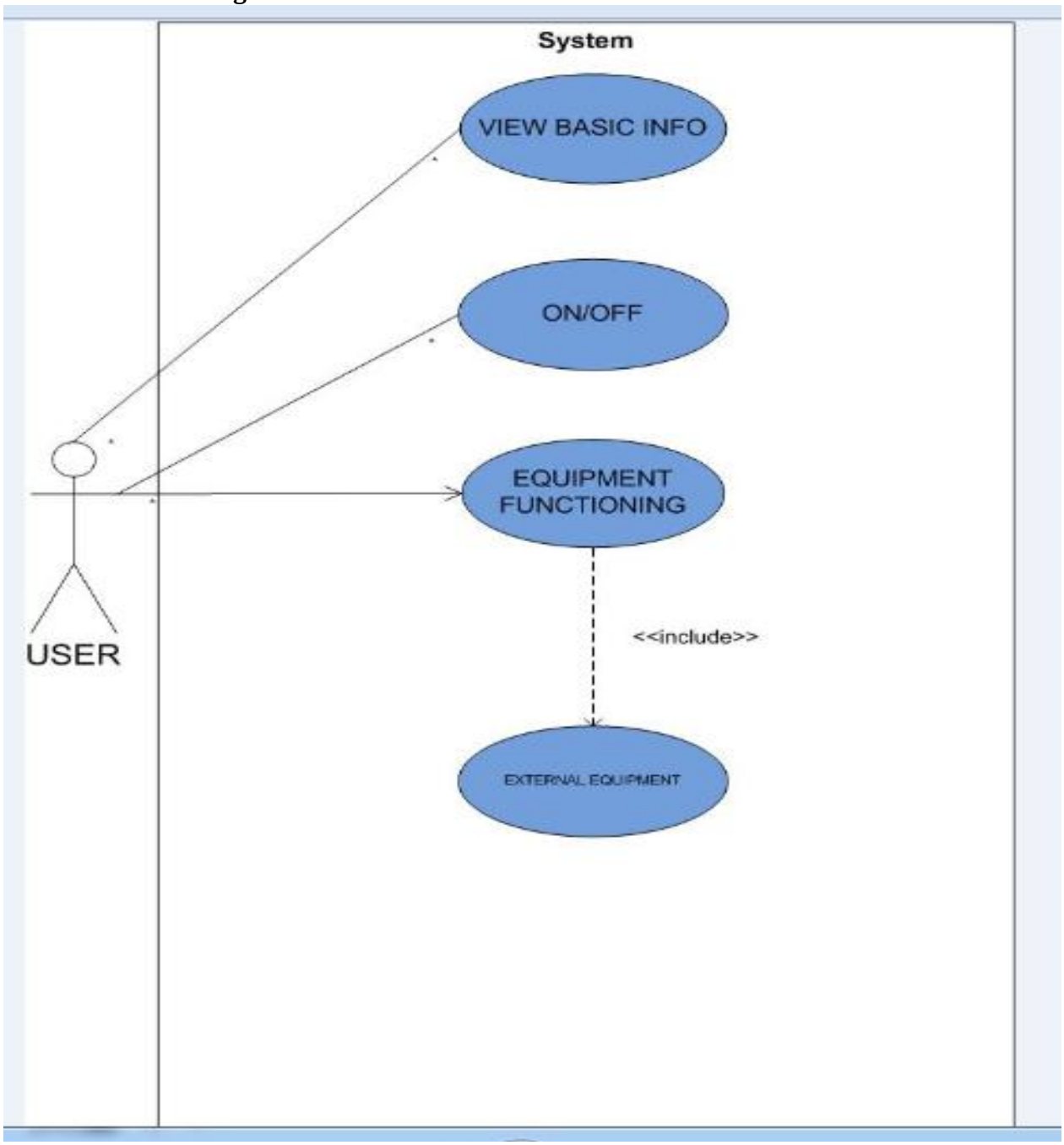


Figure 3.5 - Use Case Diagram IP NERA

3.2.3.5 Use Case Description

- **View**

Use Case ID	1		
Use Case Name	View		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	View Basic functionalities of the equipment		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the tutorial will begin explaining the basic functionalities of the equiment		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for viewing basic information • This functionality is explained with the help of visuals, written text and audio		

- **Equipment Functioning**

Use Case ID	2		
Use Case Name	Equipment functioning		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	This will explain the complete functioning of IP NERA		
Pre-Conditions	The actor has to open the application on PC and login		

Post-Conditions	If the use case is successful the tutorial will begin explaining the complete functionailty of the equipment
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for viewing complete functionality of the equipment • This functionality is explained with the help of visuals, written text, audio and all other external equipements which can be connected with IP NERA to make communication and networking possible

3.2.3.5 Use Case Diagrams for TEST

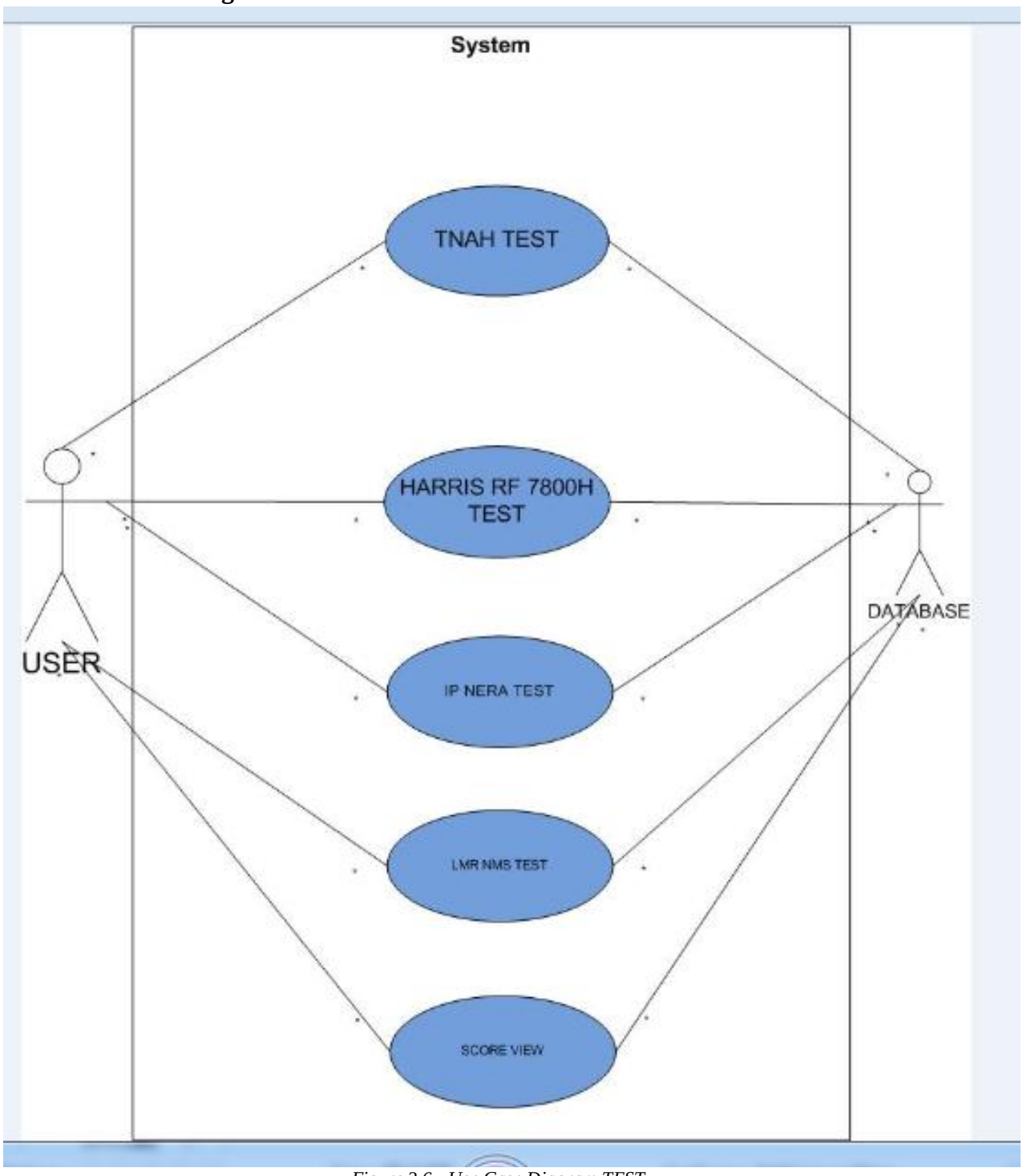


Figure 3.6 - Use Case Diagram TEST

3.2.3.5 Use Case Description

- **LMR NMS Test**

Use Case ID	1		
Use Case Name	LMR NMS TEST		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Take LMR NMS test		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the test for LMR NMS will begin		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for test of LMR • Test is conducted in form of MCQ's • Score is displayed which is saved in database		

- **HARRIS Test**

Use Case ID	2		
Use Case Name	HARRIS TEST		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Take HARRIS RF7800H test		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the test for HARRIS RF7800H will begin		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for test of HARRIS		

	• Test is conducted in form of MCQ's • Score is displayed which is saved in database

- **TNAH-6010Test**

Use Case ID	1		
Use Case Name	TNAH-6010 TEST		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Take TNAH-6010 test		
Pre-Conditions	The actor has to open the application on PC and login		
Post-Conditions	If the use case is successful the test for TNAH-6010 will begin		
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for test of TNAH 6010 • Test is conducted in form of MCQ's • Score is displayed which is saved in database		

- **IP NERA Test**

Use Case ID	1		
Use Case Name	IP NERA TEST		
Actors	User		
Created By	Bilal	**Last Updated By**	Group Members
Date Created	19/12/2019	**Last Updated**	19/12/2019
Description	Take IP NERA test		

Pre-Conditions	The actor has to open the application on PC and login
Post-Conditions	If the use case is successful the test for IP NERA will begin
Normal Flow(Primary Scenario)	• The use case starts when an actor opens the application • He then selects functionality for test of IP NERA • Test is conducted in form of MCQ's • Score is displayed which is saved in database

3.2.4 Class Diagram

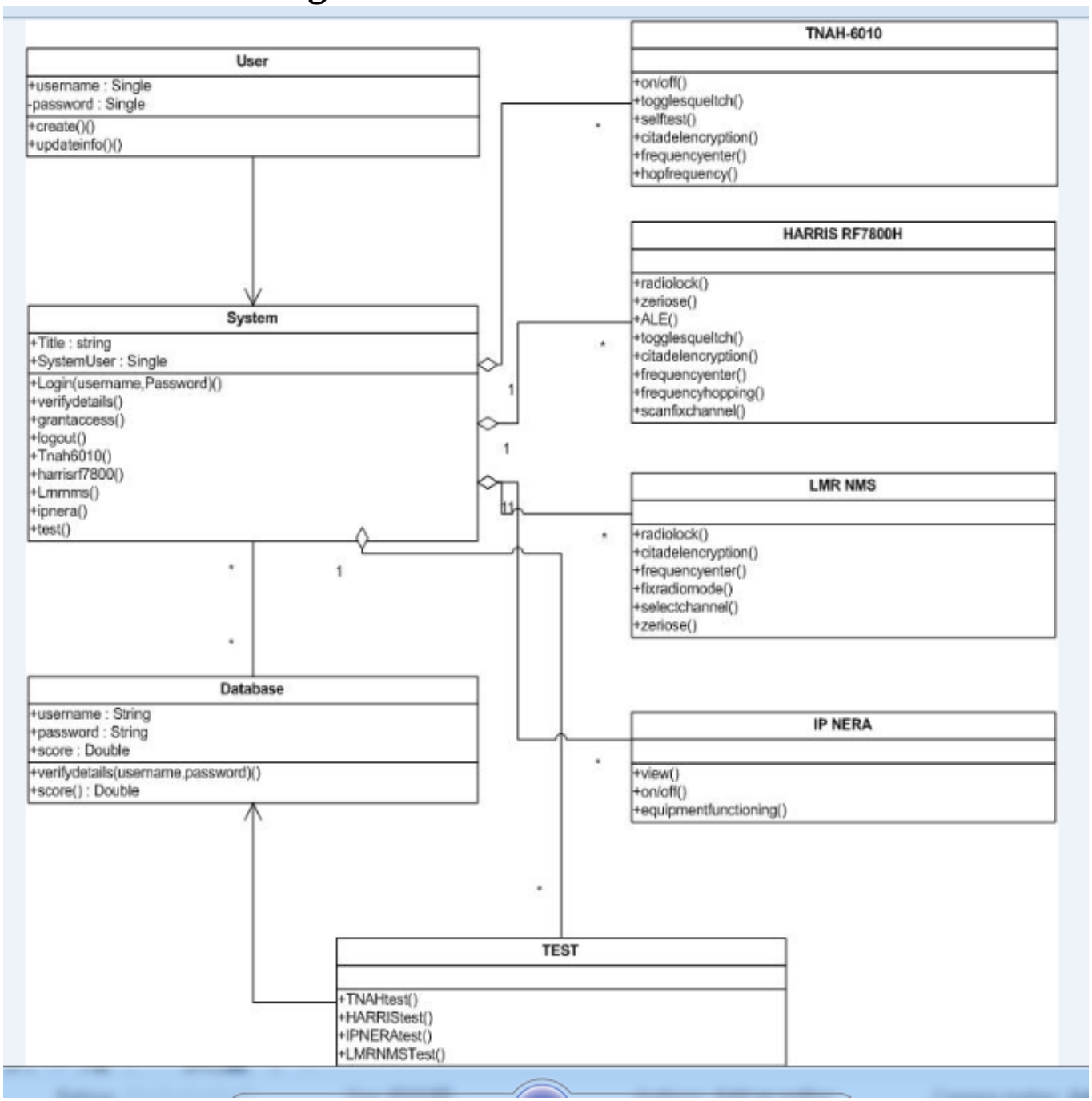


Figure 4 - Class Diagram

Class Name	Description
System	This class contains the origin for the function SEATS has to perform. It is the main class which will be acting as a gateway to all the other classes
User	User class contains all the information related to user management. Contains username and password for login purposes
Test	This contains test functions for various equipment
Database	For user management purposes
TNAH-6010	This includes data and operations for various tutorials included for the equipment.
LMR NMS	This includes data and operations for various tutorials included for the equipment.
IP NERA	This includes data and operations for various tutorials included for the equipment.
HARRIS RF 7800H	This includes data and operations for various tutorials included for the equipment.

3.3 Activity Diagrams

The diagram below shows various activities involved while interaction with the SEATS. User opens the application, and then he has to provide his login details. These details are verified from a database. If an error occurs the user is returned again to the login page, if the user is verified he is granted access and is moved to the main window. From here he can select the equipment for which he wants to take GUI based training or either he can take a test.

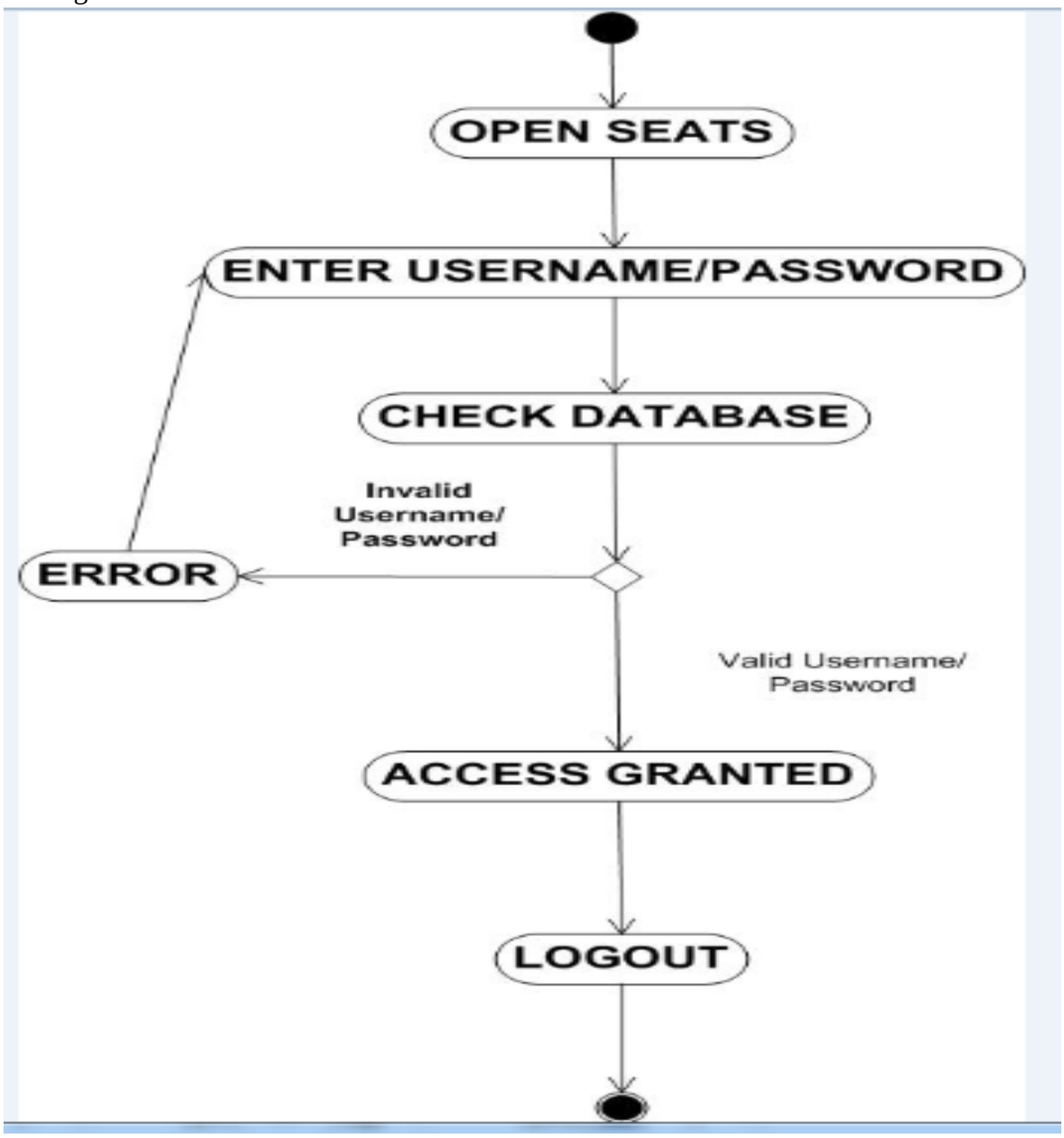


Figure 6 -Activity Diagram SEATS ACCESS

- Activity Diagram TNAH-6010 Tutorials

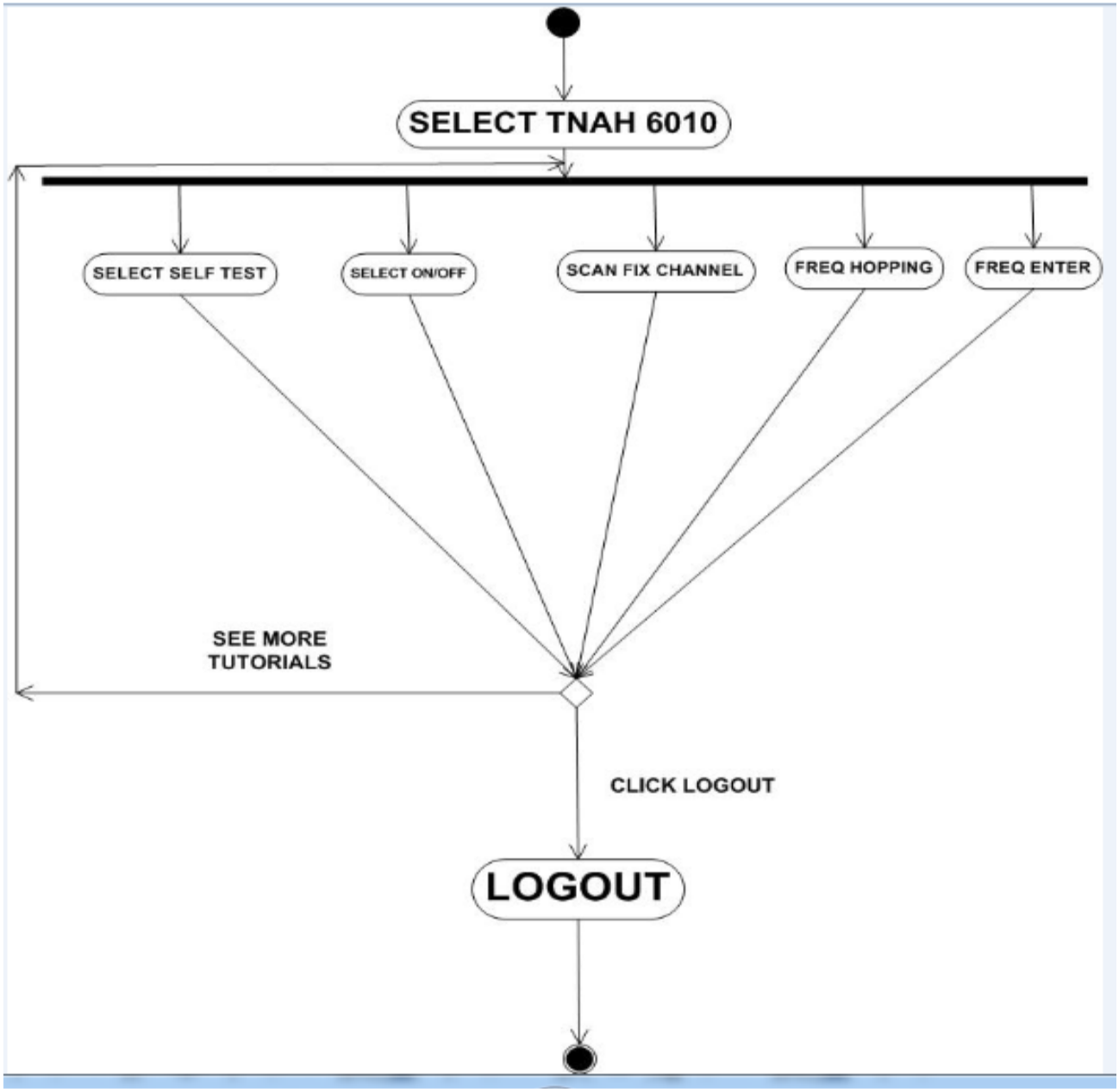


Fig 6.1 Activity Diagram TNAH 6010

- Activity Diagram selecting HARRIS Tutorials

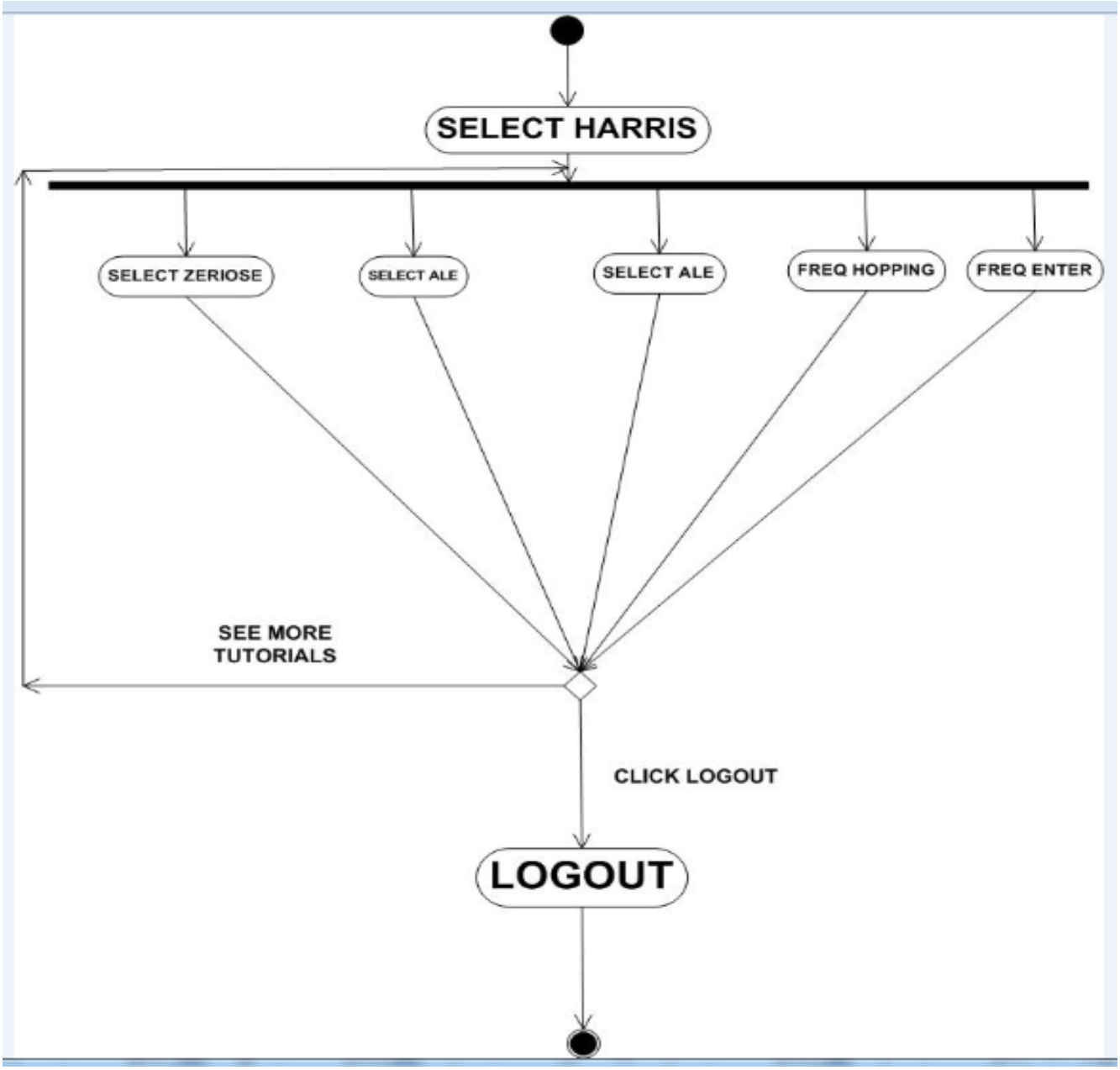


Fig 6.3 Activity Diagram HARRIS

- Activity Diagram LMR NMS Tutorials

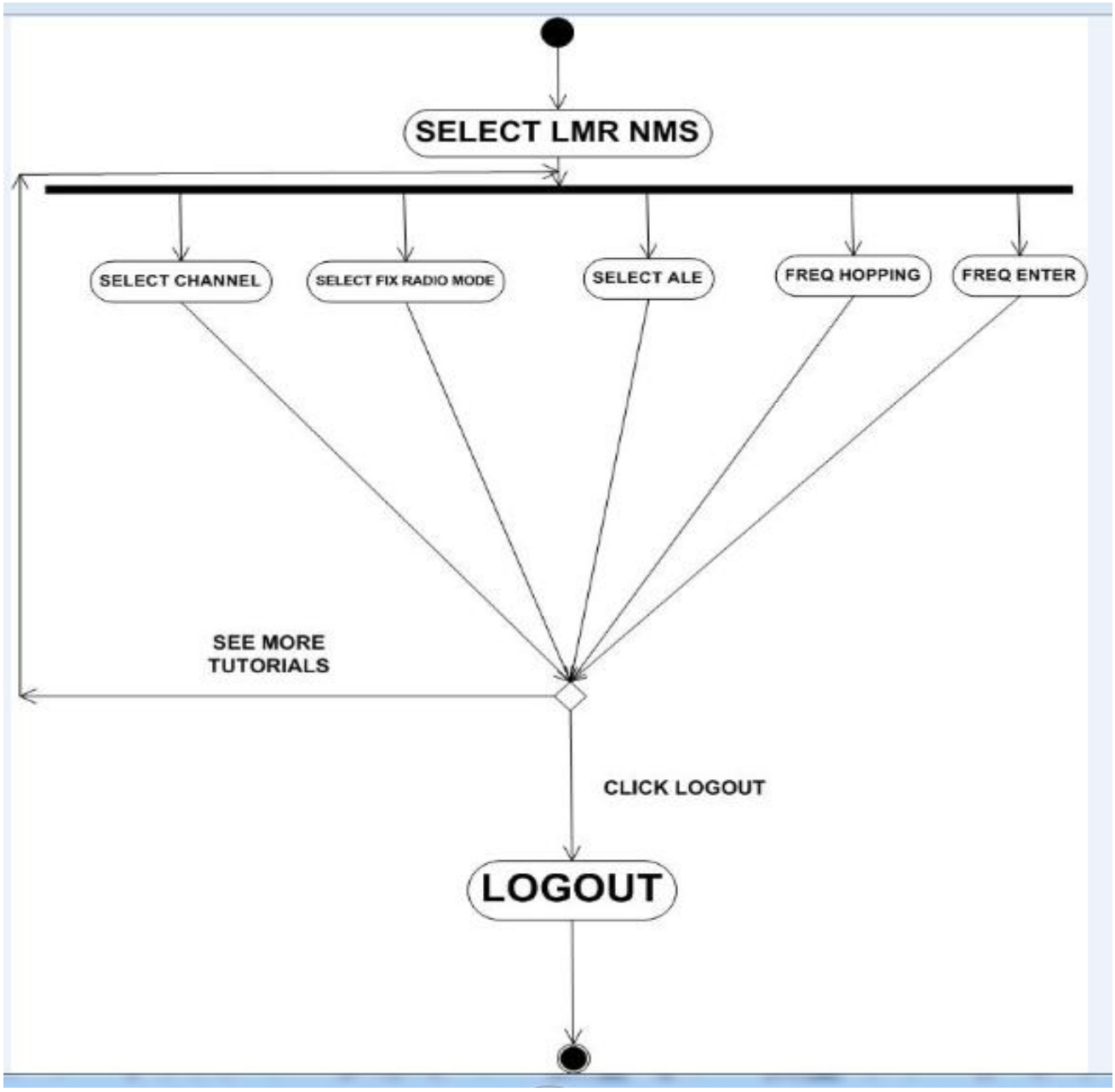


Fig 6.4 Activity Diagram LMR NMS

- Activity Diagram IP NERA Tutorials

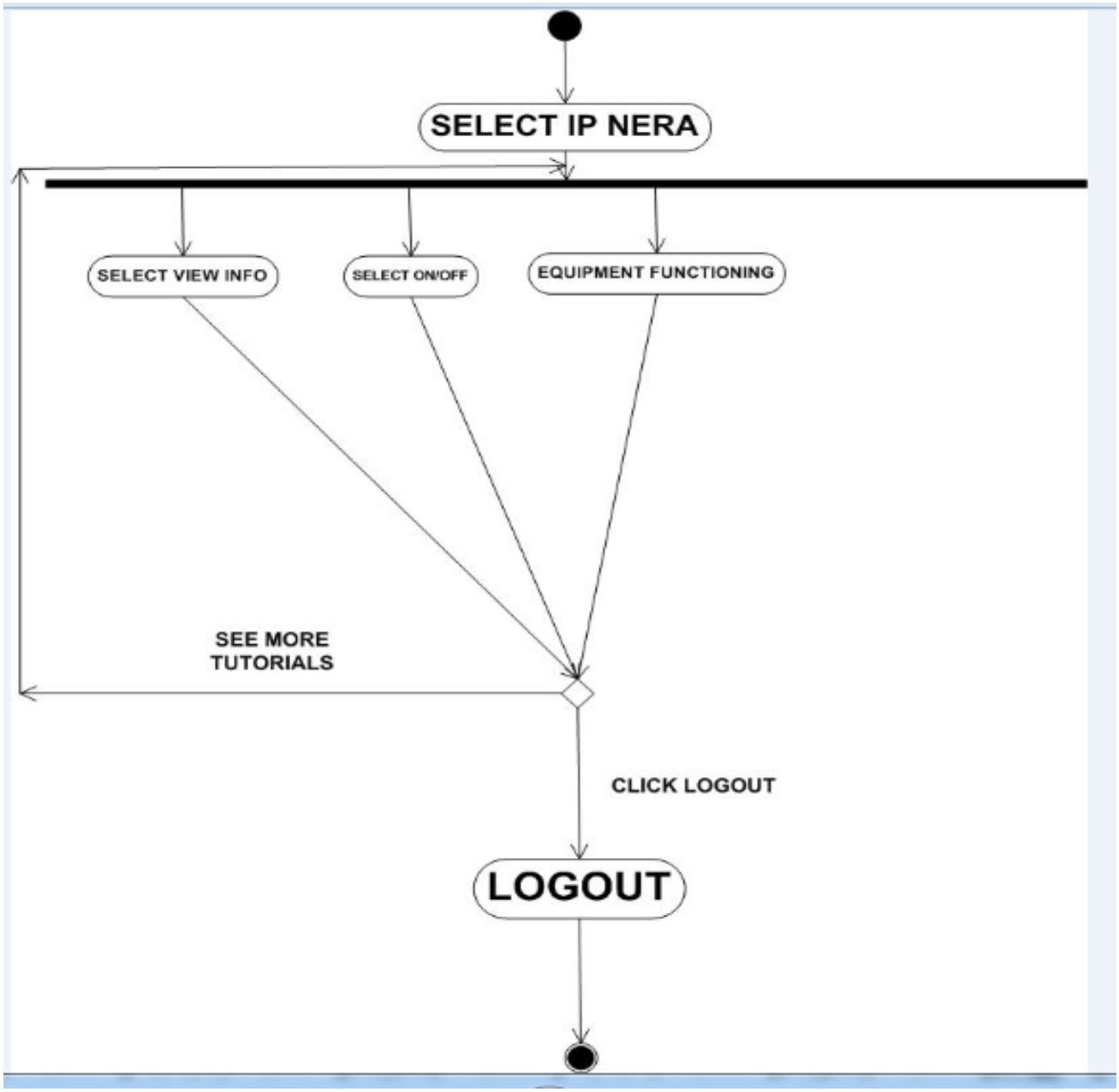


Fig 6.5 Activity Diagram IP NERA

- Activity Diagram TEST Tutorials

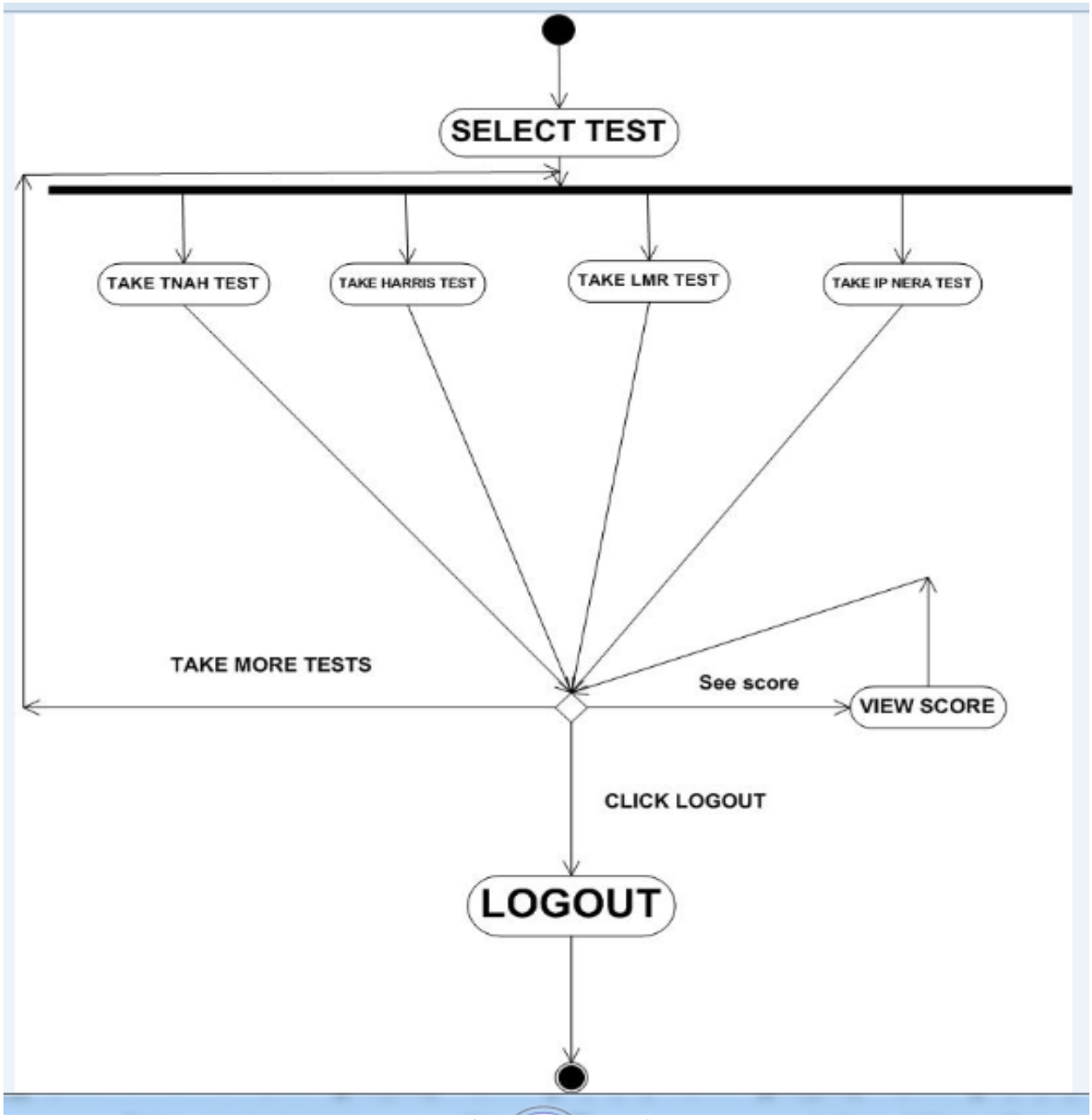


Fig 6.6 Activity Diagram TEST

3.4 Sequence Diagrams (Dynamic View)

3.4.1 Login-Success & Failure

The following diagram shows the sequence of events as a user logs into SEATS system

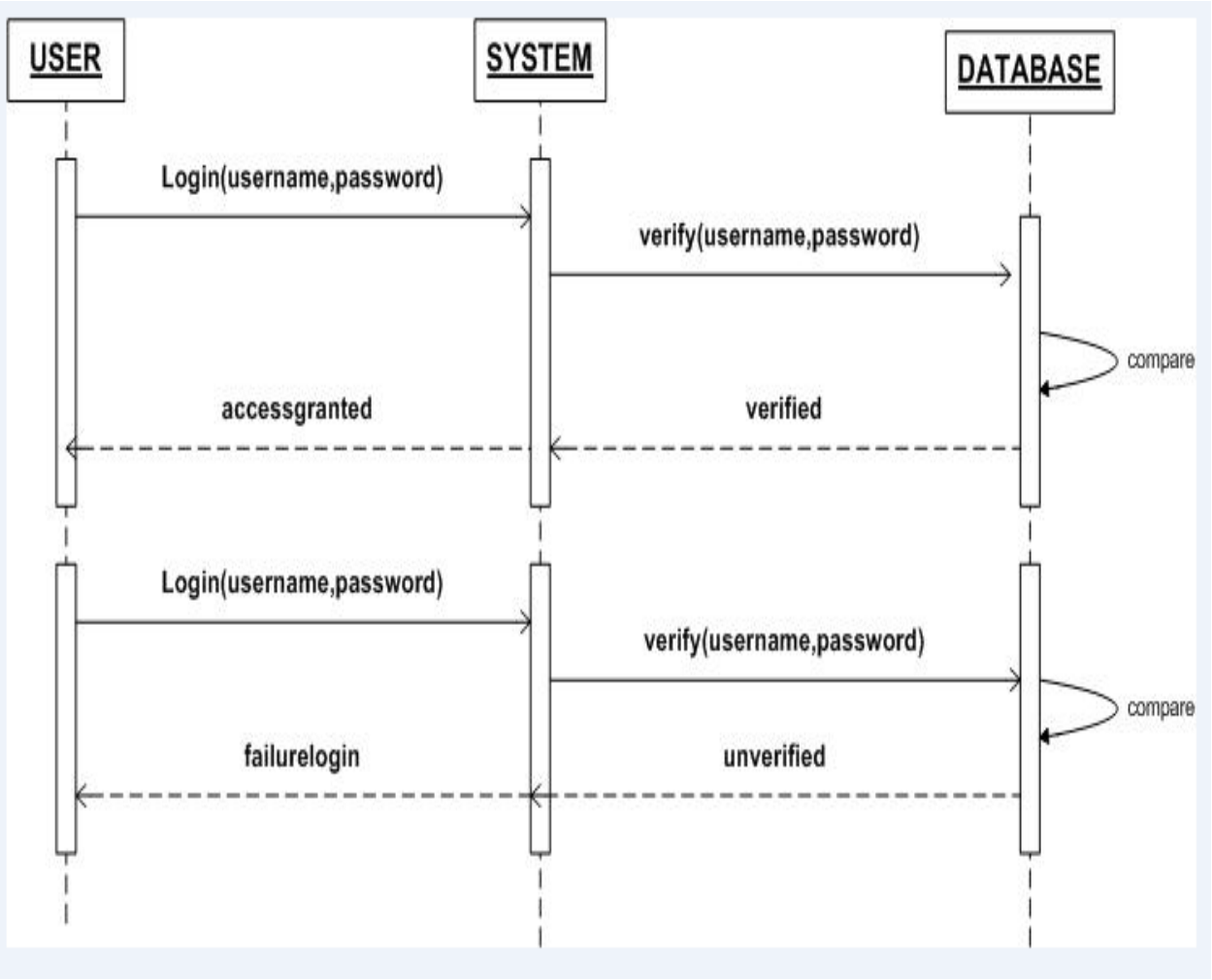


Fig 7.1 Sequence Diagram Login SEATS

3.4.2 TNAH-6010

The following diagram shows the sequence of events as a user selects TNAH-6010 for training

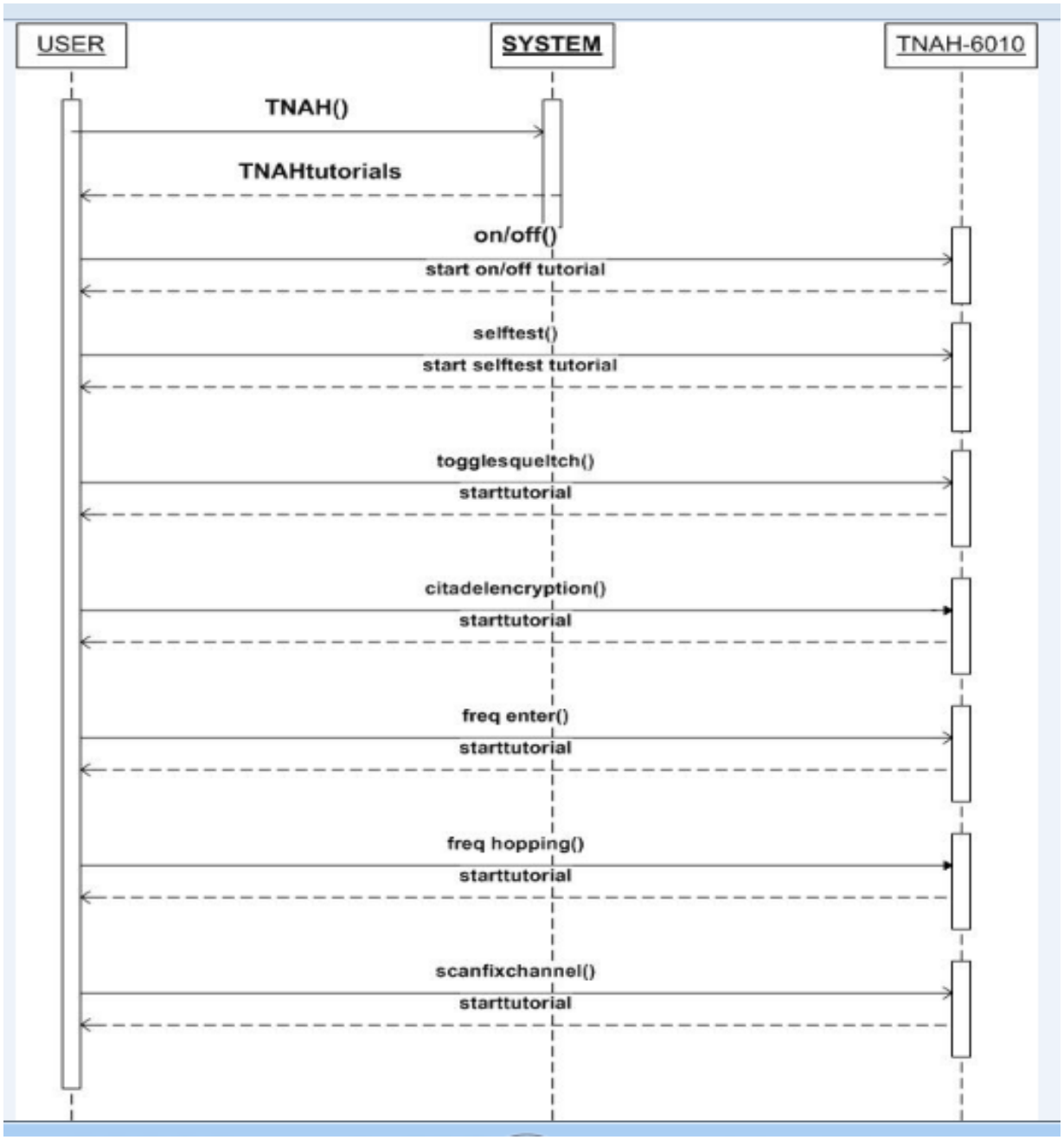


Fig 7.2 Sequence Diagram TNAH 6010

3.4.3 HARRIS RF 7800H

The following diagram shows the sequence of events as a user selects HARRIS RF 7800H for training

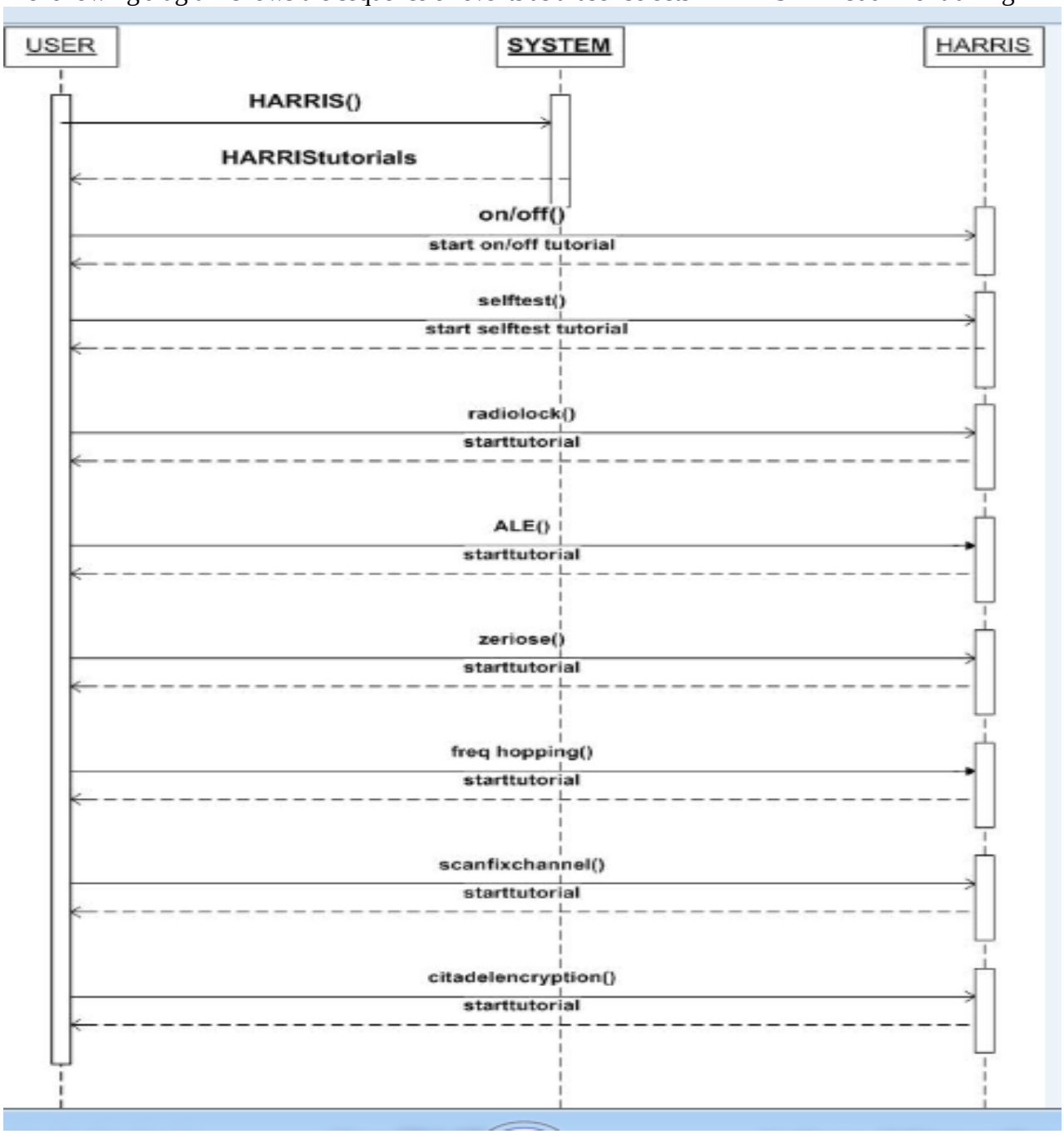


Fig 7.3 Sequence Diagram HARRIS

3.4.4 LMR NMS

The following diagram shows the sequence of events as a user selects LMR NMS for training

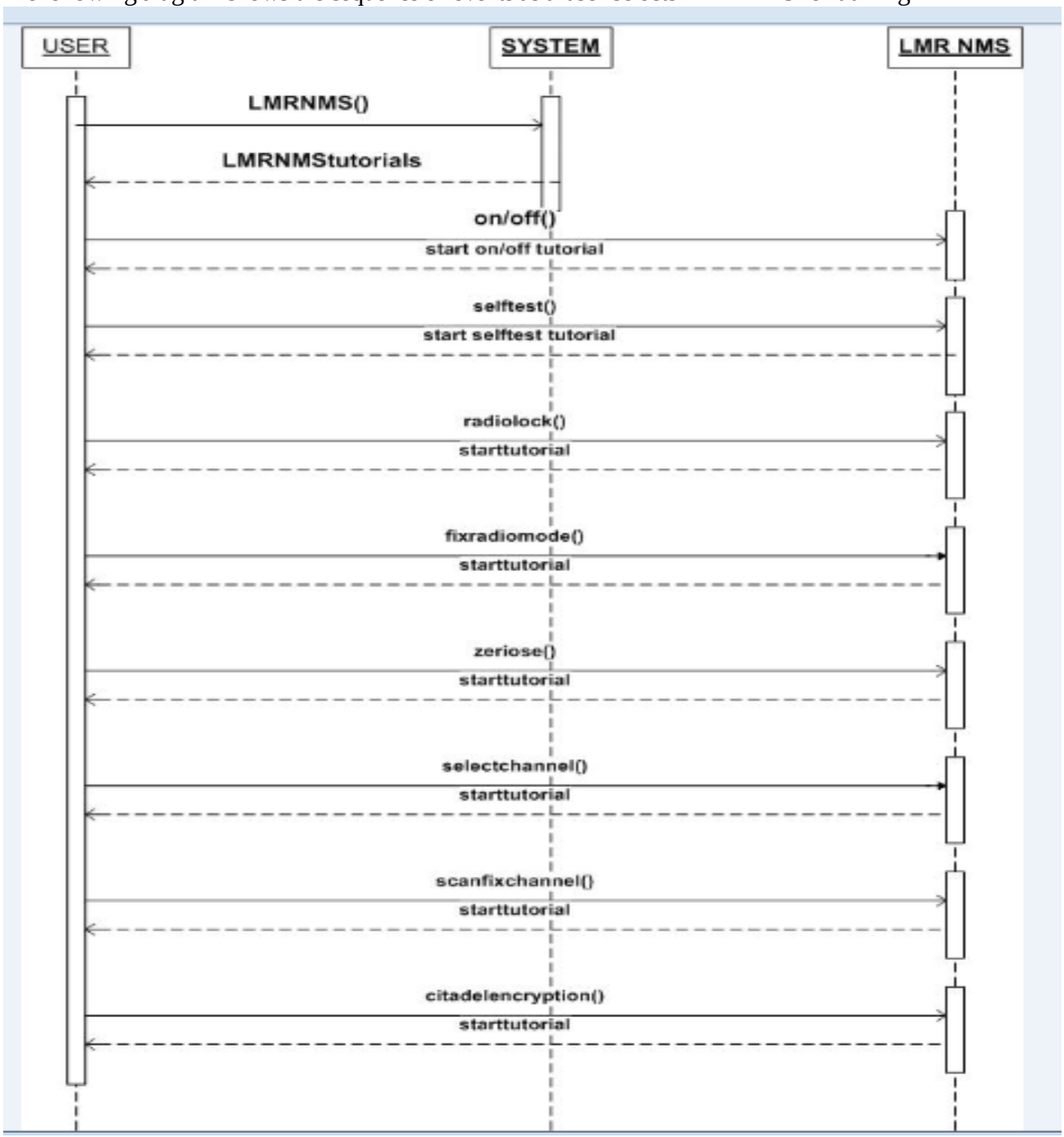


Fig 7.4 Sequence Diagram LMR NMS

3.4.5 IP NERA

The following diagram shows the sequence of events as a user selects IP NERA for training

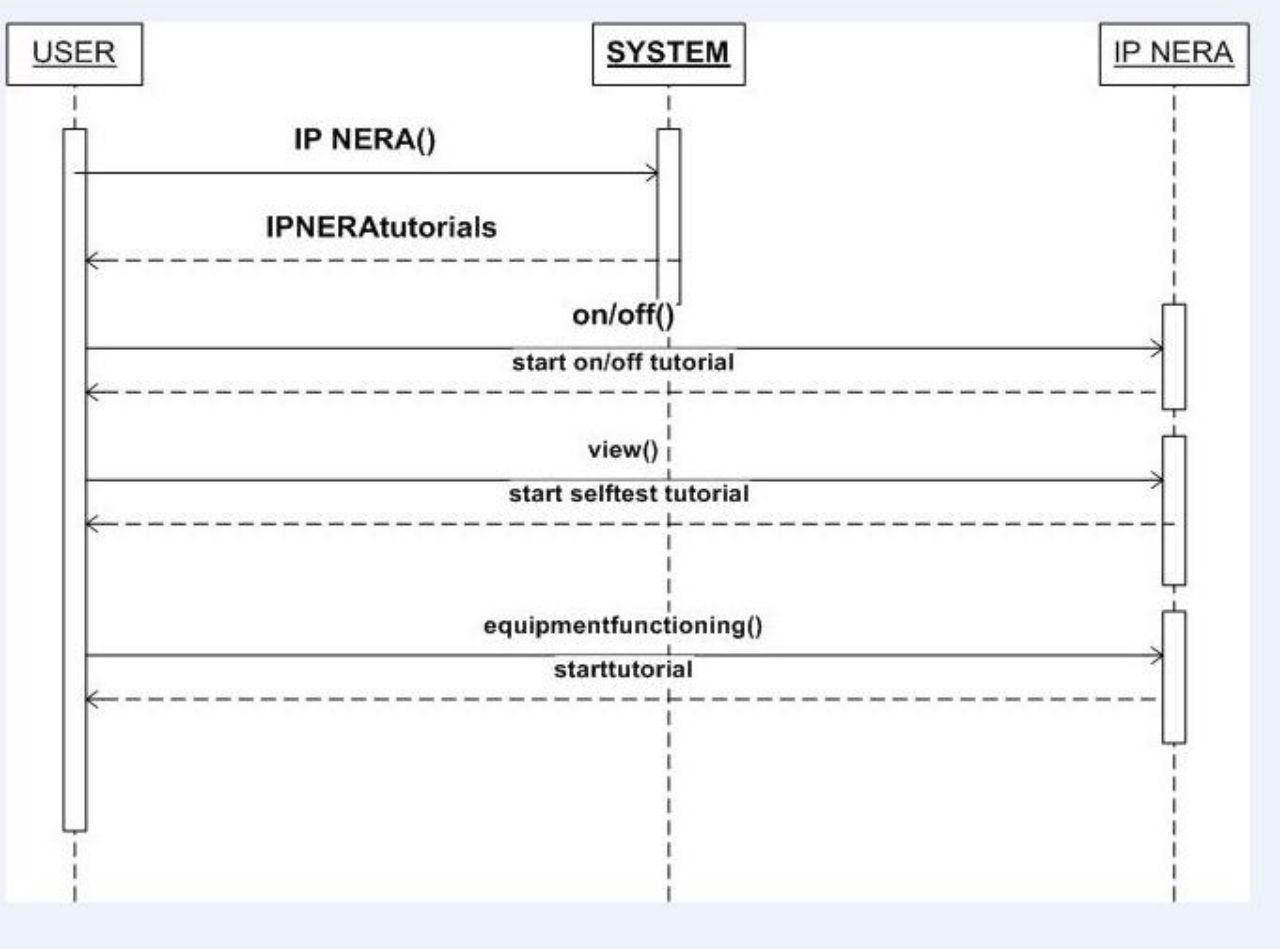


Fig 7.5 Sequence Diagram IP NERA

3.4.6 Test

The following diagram shows the sequence of events as a user selects test functionality

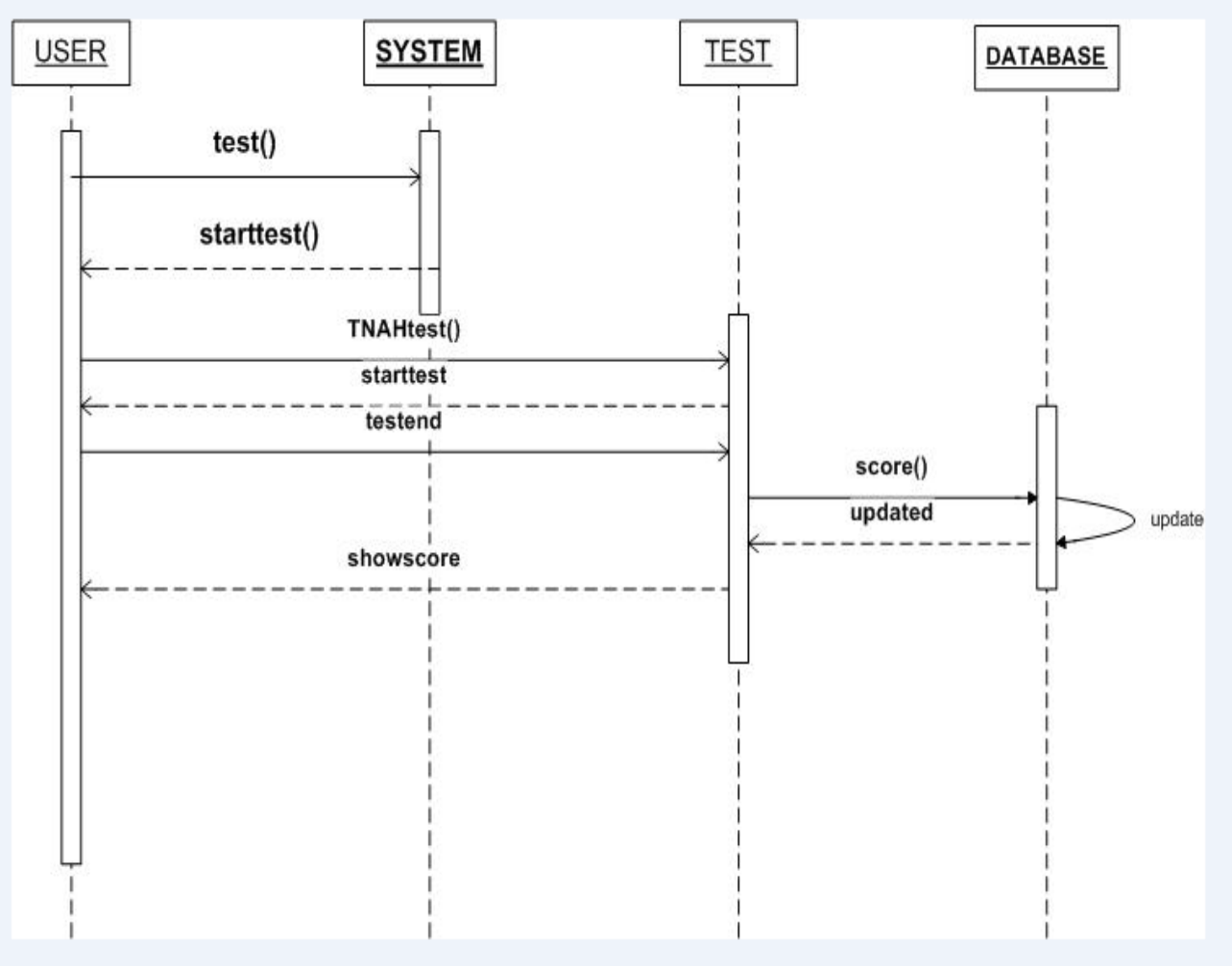


Fig 7.6 Sequence Diagram Test

4 Detailed Descriptions of Components

4.1 System Class

Identification	**System Class**
Type	Class
Purpose	• To manage user's login and logout • To access the desired equipment for training • Take test
Function	• Works along with the login screen • Imports and Exports can be used for data entry or reports • TNAH() • IP NERA() • HARRIS() • TEST() • LMR NMS()
Subordinates	• Main System User • User database will be used to hold the user records when test is taken
Dependencies	• requires data from database for authentication
Interfaces	• Login Screen, as well as UIs for import and export of data • UI for all sets • UI for test
Resources	• Database,
Processing	• Login(Username, Password), VerifyDetails(), GrantAccess() and Logout() used for User Management • TNAH() calls training functionality for TNAH eqpt • IP NERA() calls training functionality for IP NERA eqpt • LMR NMS() calls training functionality for LMR NMS eqpt • HARRIS() calls training functionality for HARRIS eqpt Test() calls test functionality for various tests
Data	• Database

4.2 TNAH-6010

Identification	**TNAH-6010**
Type	• Class
Purpose	• To access GUI based training
Function	• On/off() • Self test() • Toggle squelch() • Citadel encryption() • Frequency enter() • Hop frequency()
Subordinates	-
Dependencies	-.
Interfaces	• Then front panel GUI of TNAH-6010
Resources	• Database
Processing	• On/off() starts on/off turotial • Self test() starts self test tutorial • Toggle squelch() starts toggle squelch tutorial • Citadel encryption() starts citadel encryption tutorial • Frequency enter() starts frequency enter tutorial • Hop frequency() starts hop frequency tutorial
Data	-

4.3 HARRIS RF 5800H

Identification	HARRIS RF 5800H
Type	Class
Purpose	• To access GUI based training
Function	• On/off() • Self test() • Toggle squelch() • Citadel encryption() • Frequency enter() • Hop frequency() • Radio lock() • Zeriose() • ALE()
Subordinates	-
Dependencies	-.
Interfaces	• Then front panel GUI of HARRIS RF 5800H
Resources	• Database
Processing	• On/off() starts on/off tutorial • Self test() starts self test tutorial • Toggle squelch() starts toggle squelch tutorial • Citadel encryption() starts citadel encryption tutorial • Frequency enter() starts frequency enter tutorial • Hop frequency() starts hop frequency tutorial • Radio lock() starts radio lock turorial • ALE() starts ALE tutorial • Zeriose starts Zeriose tutorial
Data	-

4.4 LMR NMS

Identification	**LMR NMS**
Type	Class
Purpose	• To access GUI based training
Function	• On/off() • encryption() • Frequency select() • Fix radio mode() • Select channel()
Subordinates	-
Dependencies	-.
Interfaces	• Then front panel GUI of LMR NMS
Resources	Database
Processing	• On/off() starts on/off tutorial • Encryption() starts citadel encryption tutorial • Frequency select() starts frequency select tutorial • Fix radio mode() starts fix radio mode tutorial • Select channel() starts select channel tutorial
Data	-

4.5 IP NERA

Identification	**IP NERA**
Type	Class
Purpose	• To access GUI based training
Function	• On/off() • View() • Equipment functioning()
Subordinates	-
Dependencies	-.
Interfaces	• Then front panel GUI of IP NERA
Resources	Database
Processing	• On/off() starts tutorial for ON/OFF • View() starts tutorial for view • Equipment functioning () starts tutorial for equipment functioning
Data	-

4.6 TEST

Identification	**TEST**
Type	Class
Purpose	• To access test of various sets
Function	• Call mcq based tests of various sets
Subordinates	-
Dependencies	-.
Interfaces	• MCQ based tests
Resources	• Database
Processing	• Testtnah() calls test of TNAH eqpt • testLMR() calls test of lmr • testIPNERA() calls test of IP NERA • testHARRIS() calls test of HARRIS set
Data	-

5 UI Design

The system under development shall support an intuitive and easy to use UI that will have an extremely shallow learning curve and require minimum training to be operated at maximum efficiency.

5.1.1 User Interface

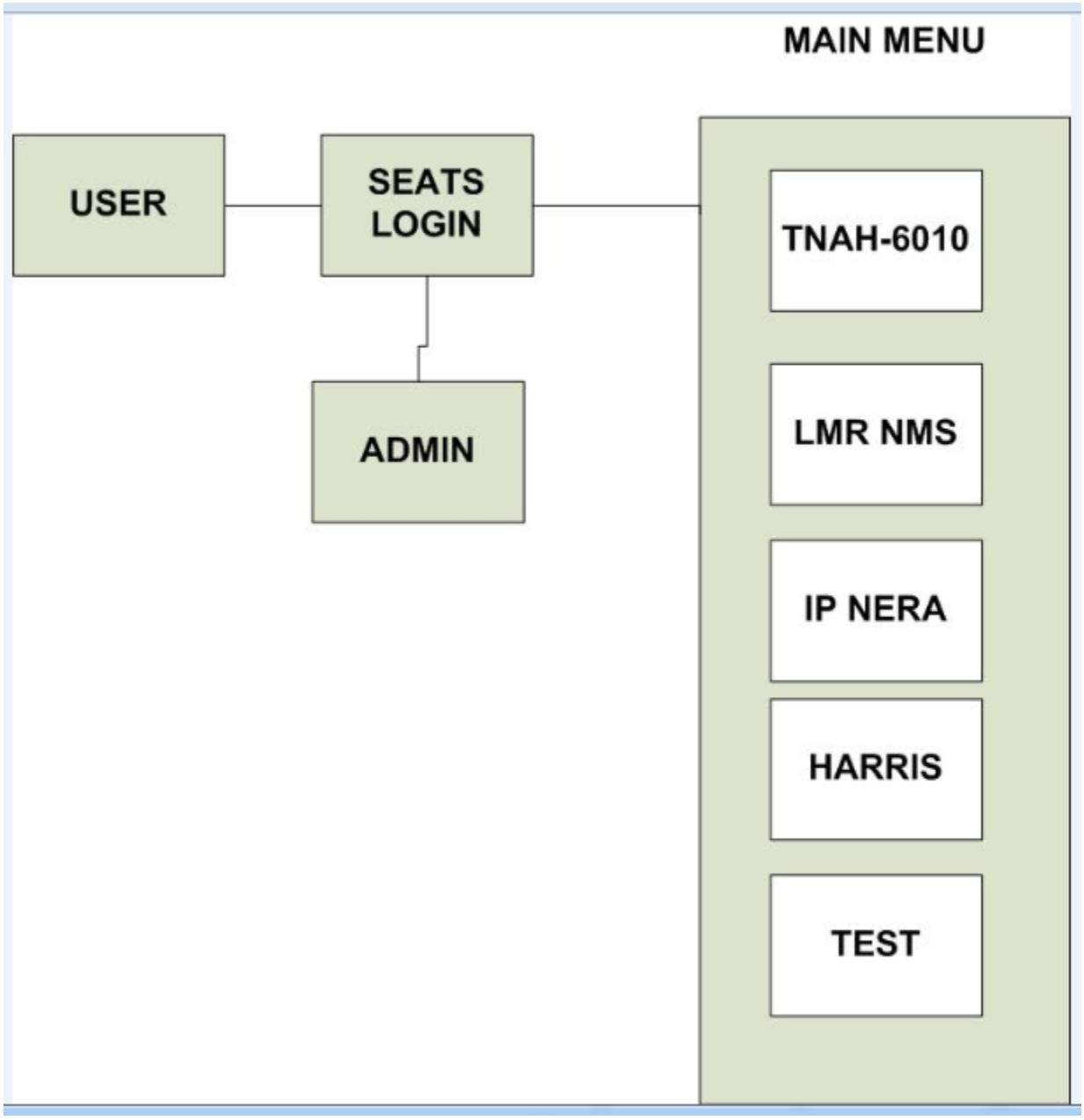


Figure 5 – User Interface Abstract Layout

5.1.2 Description of the Diagram

5.1.2.1 Login

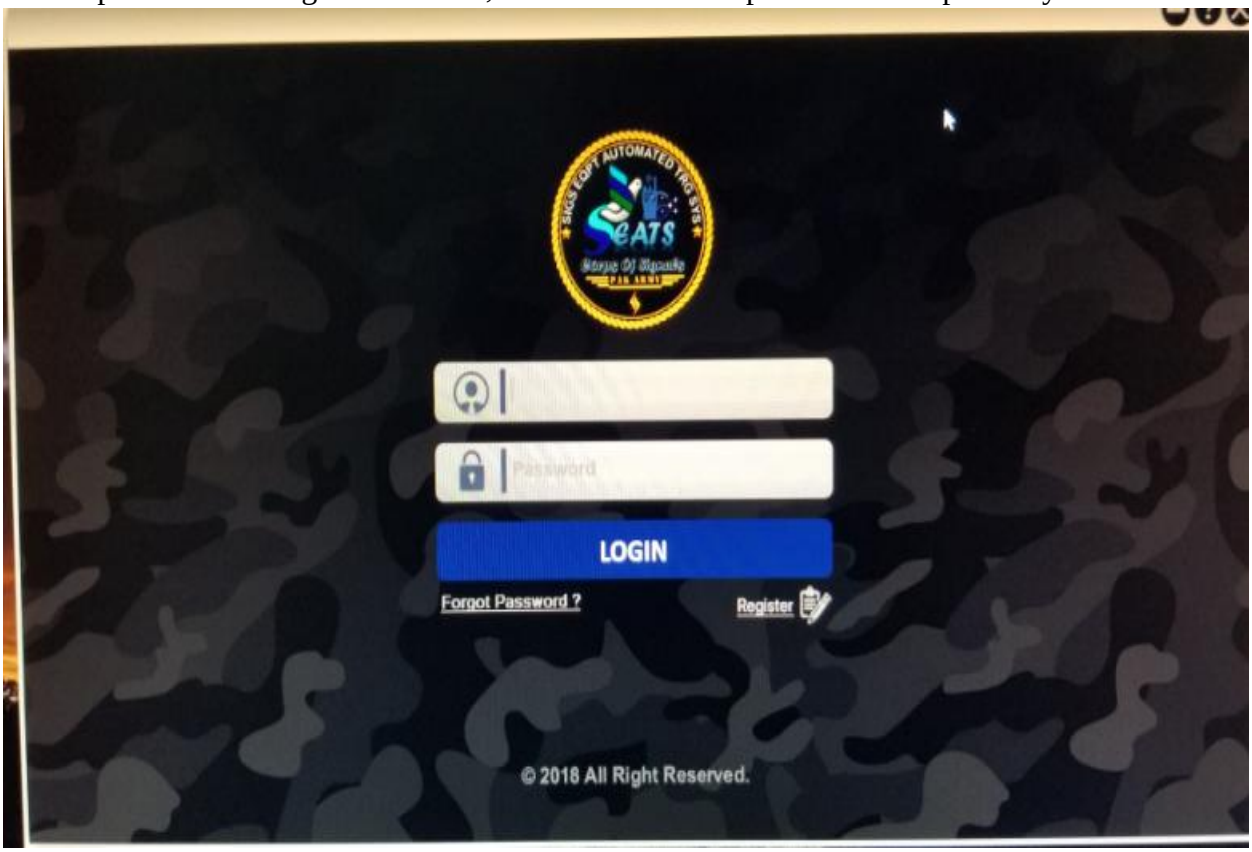
This is the initial login screen, which takes username and password as input. After a successful login, the user is sent to the main interface

5.1.2.2 Main Window

This is the main menu page. User selects the equipment for which he wants to have GUI based training or he selects the test functionality after that.

5.2 Login Screen

Following are the sketches of a possible UI implementation for SEATS. This will be the first screen that the user sees upon opening the SEATS. The user shall be presented with a form to enter username and password for login. As visible, the interface is simple and self-explanatory



5.3 Main Page

5.4 Other Screenshots

6. Reuse and relationship to other Products

SEATS v1 was developed last year. SEATS v2 includes some improvements in functionalities of SEATS v1 as well as addition of four new radio sets/equipment. SEATS will be used in complete Pakistan Army for GUI based training of soldiers.

7. Design Decision and Trade offs

We have kept the user interface simple and friendly so even a user with only basic knowledge of computer usage can use it effectively.

Since this application is a new development effort for implementation in Army, our focus was to develop an application that is simple enough for an average user to use, while still providing the required features along with.

8. Pseudo code for implementation

```
Begin
Enter Login Credentials
    If Profile is invalid
        Go back to login screen
    Else
        Go to main Menu

        Select Option
            If TNAH-6010
                Go to TNAH functionalities
```

If HARRIS RF 5800H
Go to HARRIS functionalities
If LMR NMS
Go to LMR NMS functionalities
If IP NERA
Go to IP NERA functionality
If test
Take test
End

9. Requirement Matrix

Requirement ID	Requirement Description	Component
4.1	Login	System class with login verification will deal with this
4.2	TNAH Tutorials	TNAH class
4.3	LMR NMS Tutorials	LMR NMS Class
4.4	HARRIS RF 7800H Tutorials	HARRIS Class
4.5	IP NERA Tutorials	IP NERA Class
4.6	Test Functionality	TEST class

10. Appendix

Activity diagrams - are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams are intended to model both computational and organizational processes (i.e. workflows).

Class diagram - In the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

SDS – In the context of software, Design Specification is usually a design document that describes all data, architectural, interface and component-level design for the software. A design specification provides explicit information about the requirements for a product and how the product is to be put together.

Sequence diagram - is an interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.

SRS – A software requirements specification is a description of the software system to be developed. It lays out functional and non-functional requirements, and may include a set of use cases that describe user interactions that the software must provide.

Use case diagram - At its simplest is a representation of a user's interaction with the system and depicts the specifications of a use case. A use case diagram can portray the different types of users of a system and the case and will often be accompanied by other types of diagrams as well.

CHAPTER #4

QUALITY ASSURANCE

4.1 Introduction

This test plan document describes the appropriate strategies, process and methodologies used to plan, execute and manage testing of the "Signal equipment automated training system V2". The test plan will ensure the application requirement and standards meets the customer requirements at an accredited level.

Manual Testing will be followed which includes testing a software manually, i.e., without using any automated tool or any script. In this type, the tester takes over the role of an end-user and tests the software to identify any unexpected behavior or bug. Each Unit will be tested separately and then will be integrated with other units; therefore, Unit Testing and Integration testing will be followed. For each unit, Black box Testing is done and for combined units Acceptance Testing is done.

The test scope includes the Testing of all functional, application performance and use cases requirements listed in the requirement document. Software testing, depending on the testing method employed, can be implemented at any time in the development process. However, most of the test effort occurs after the requirements have been defined and the coding process has been completed.

This document includes the plan, scope, approach and procedure the testing of "Signal equipment automated training system version 2" application. The pass/fail criteria of the test items are also defined. The document tracks the necessary information required to effectively define the approach to be used in the testing of the product

4.2 Test Items

- Develop test cases.
- Execute tests based on the developed test cases for the software.
- Report defects from the executed test cases if any.
- Provide complete test report.
- Incorporate or manage changes later in the stage of the project development.

4.3 Features required to be Tested

Following Features are tested:

- Software will be able to login from any selected stand-alone pc after logging secret password.
- Software will be able to display the TNAH output display.
- Software will be able to display the HARRIS output display.
- Software will be able to display the IPNERA output display.
- Software will be able to display the LMR NMS output display.
- Software need to display the desired output for all these modules.
- Software will be integrated and run as one application.

4.4 Test Approaches

Acceptance test will be executed based on this acceptance test plan. And after all test cases are executed, a test report will be summarized to show the quality of simulator which provides the useful learning application. Following test approaches will be used in test execution:

- **Unit test**. Developers are responsible for unit testing. The implementation of each module and individual component will be verified separately.

- **Integration test**. After the unit test is passed above the defined quality threshold, testers will execute the integration test cases. After all the modules are integrated, it is crucial to test the product as a black-box.

- **Positive and negative testing design technique**. This approach will be combined with unit test and integration test. Test cases are designed in obvious scenarios, which ensure that all functional requirements are satisfied. What's more, different test cases will also be covered to show how the system reacts with invalid operations.

4.5 Item Pass/ Fail Criteria

Details of the test cases are specified in section Test Deliverables. Following the principles outlined below, a test item would be judged as pass or fail.

- Preconditions are met
- Inputs are carried out as specified
- The result works as what specified in output => Pass
- The system doesn't work or not the same as output specification => Fail.

4.6 Suspension Criteria and Resumption Requirements

Any bugs found can be fixed by developers quickly and no need to start the testing process from the beginning. However, when major bugs will block some test cases as they are interdependent and the testing has to be paused.

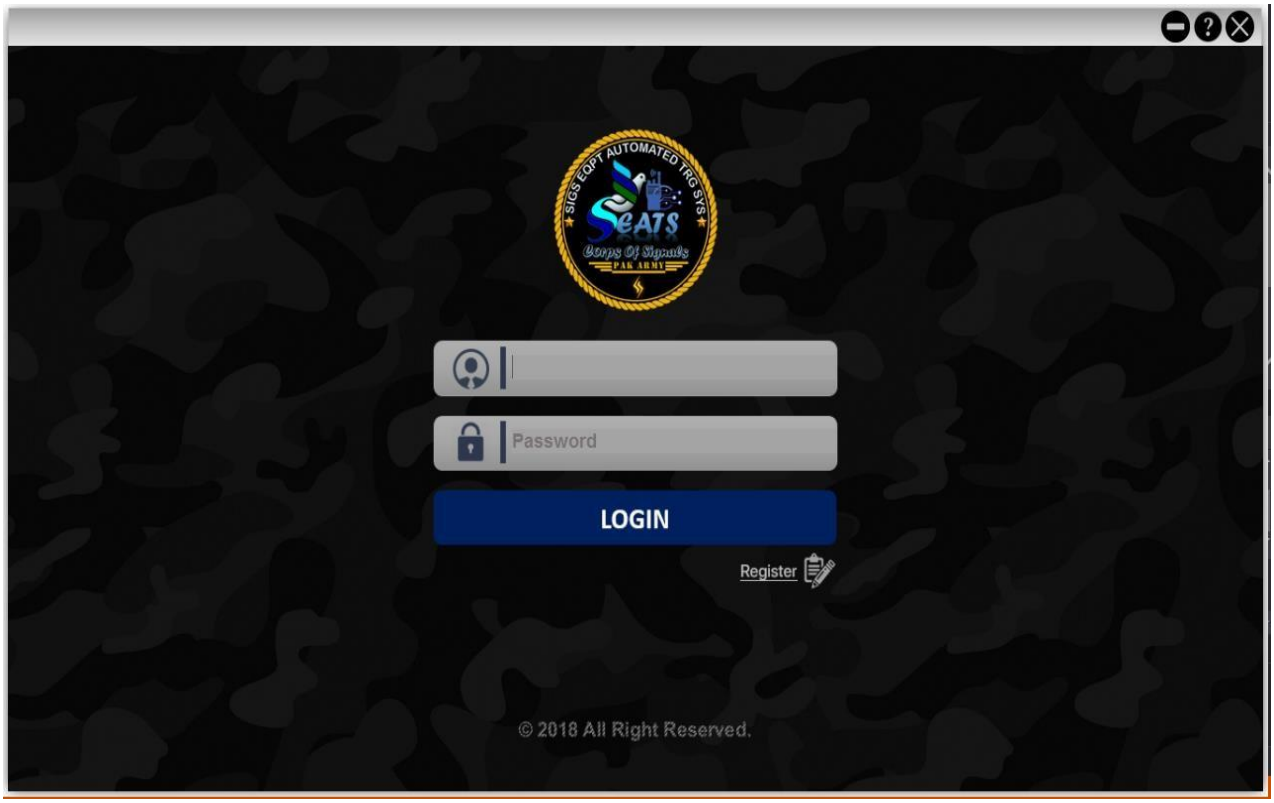
4.7 Test Deliverables

Following are the Test Cases:

4.4 User Interface Testing:

Test Case Number	01
Test Case Name	Open SEATS
Description	Testing Application whether it runs on PC or not.
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application must be installed on PC with windows 7 or higher and .NET framework 4.5 or above
Input Values	User name and password
Steps	• Click on seats icon. • Enter username and password.

	• Click login button.
Expected output	SEATS main menu will open.
Actual output	Main menu opened showing different modules added.
Status	Test case passed successfully.




SIGS EQPT AUTOMATED TRG SYS
M3TR
HARRIS
SDR-9661
NGPATCOM
HCLOS
NGPATCOM
PCU
NGPATCOM
NIU
NGPATCOM
RS-100
NGPATCOM
VG-100
NGPATCOM
CUCM
ABOUT
welcome.
Select The Radio To Learn More
Signals Equipment Automated Training System (SEATS) is primarily a defence purpose project of Signals Directorate (GHQ) to digitize and automate the learning of signal equipment by using GUI based module. The software based simulation environment provide a comprehensive Training Aid to the combat soldiers of Pakistan Army to learn the communication equipment with step by step guidance and multiple interactive tools. The software covers all the major functionalities of equipment with complete detail and easy to learn approach.
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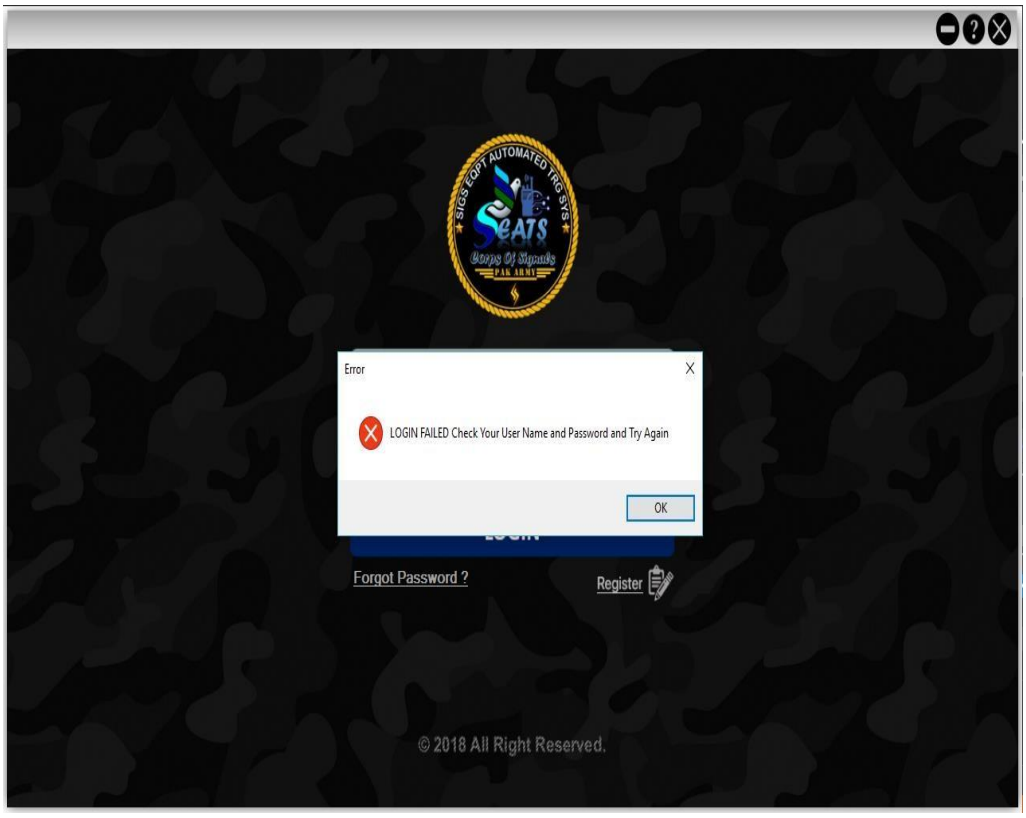
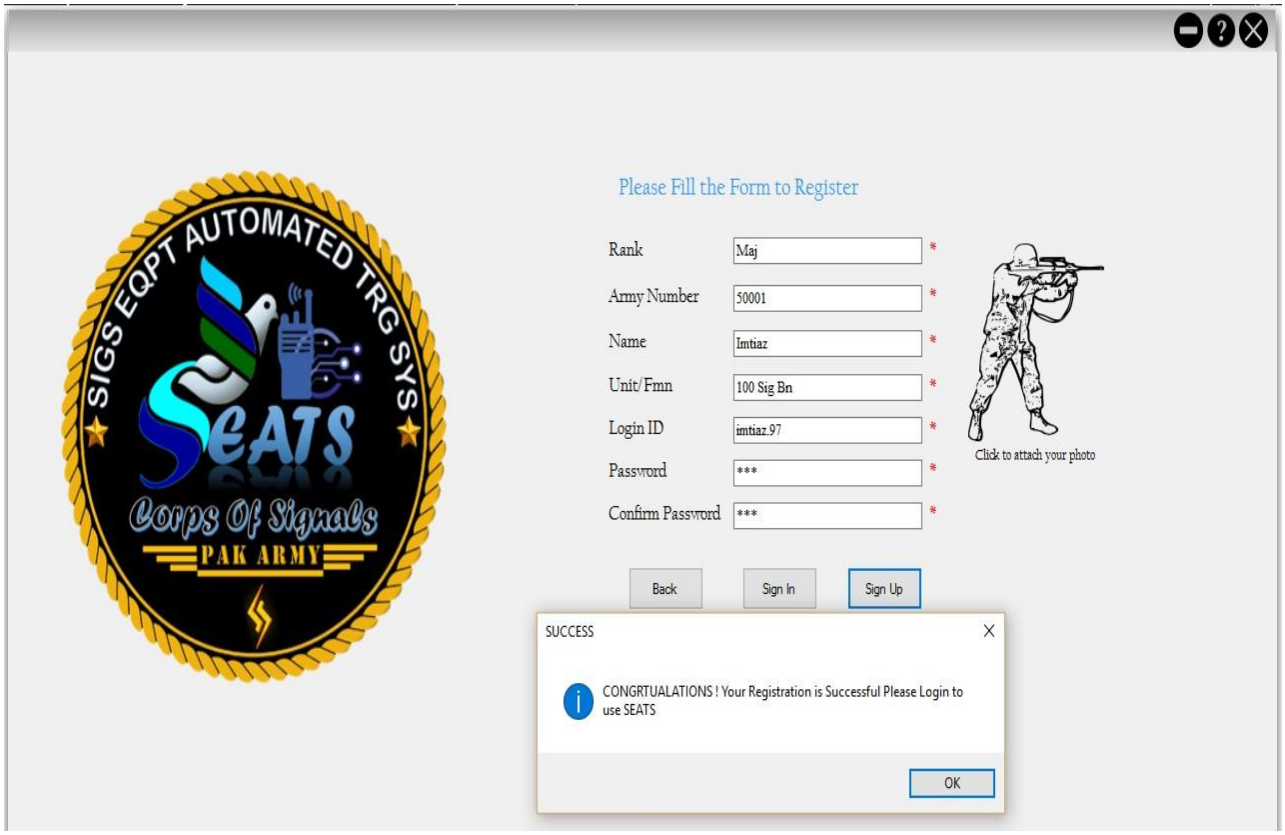
Test Case Number	02
Test Case Name	Open SEATS
Description	Testing Application whether it runs on PC or not.
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application must be installed on PC with windows 7 or higher and .NET framework 4.5 or above
Input Values	Incorrect User name/ password
Steps	• Click on seats icon. • Enter username and password. • Click login button.
Expected output	SEATS main menu will not open.
Actual output	Error message generated.
Status	Test case passed successfully.

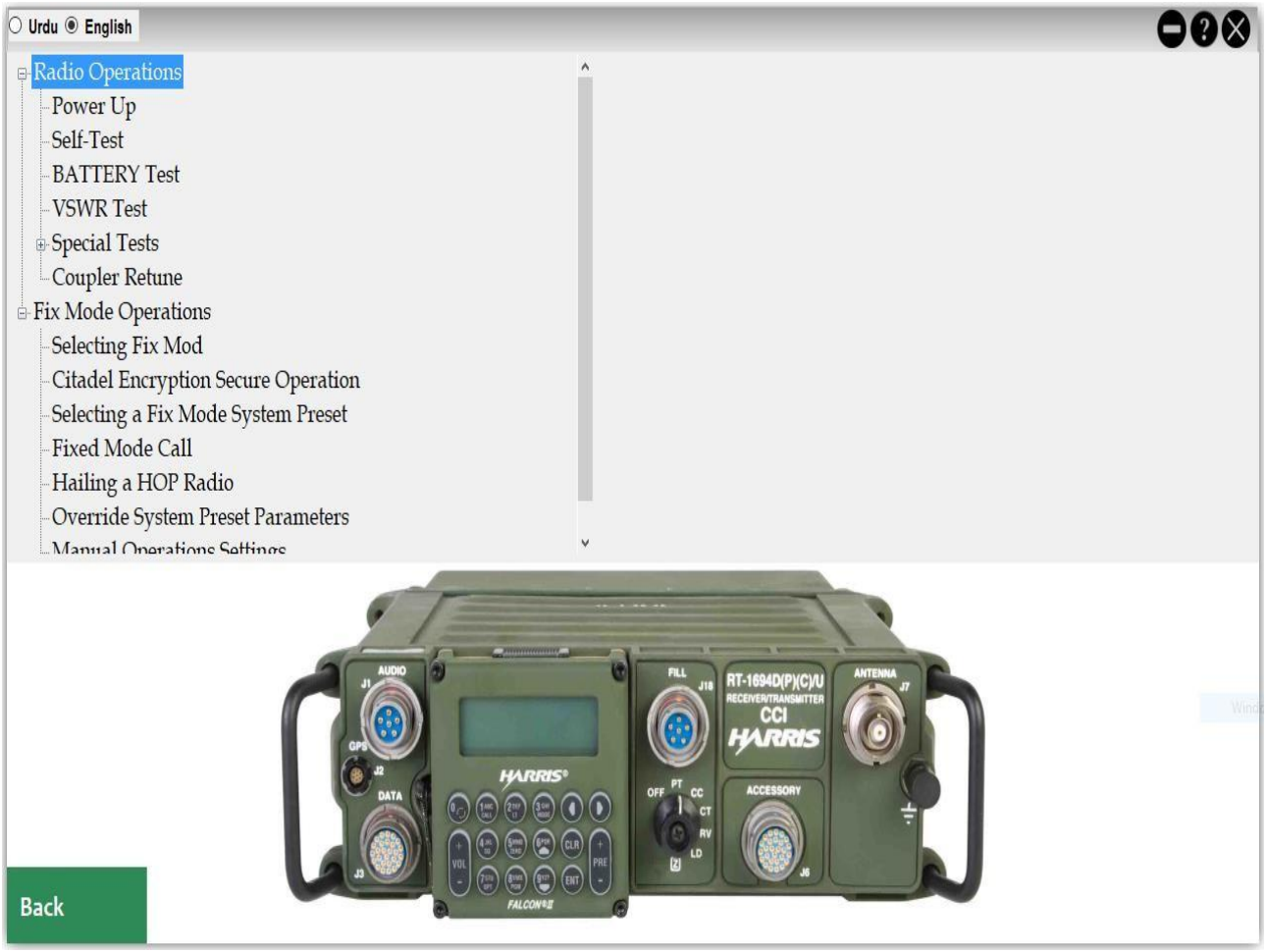


Test Case Number	03
Test Case Name	Database test case
Description	Testing function by Maintaining/Registering database of users.
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application must be installed on PC with windows 7 or higher and .NET framework 4.5 or above
Input Values	Service number, Name ,Unit, Formation, Age
Steps	• Click on seats icon. • Click on register. • Enter particulars. • Save particulars
Expected output	Interface should be displayed with successful message .
Actual output	Message displayed successfully
Status	Test case passed successfully.



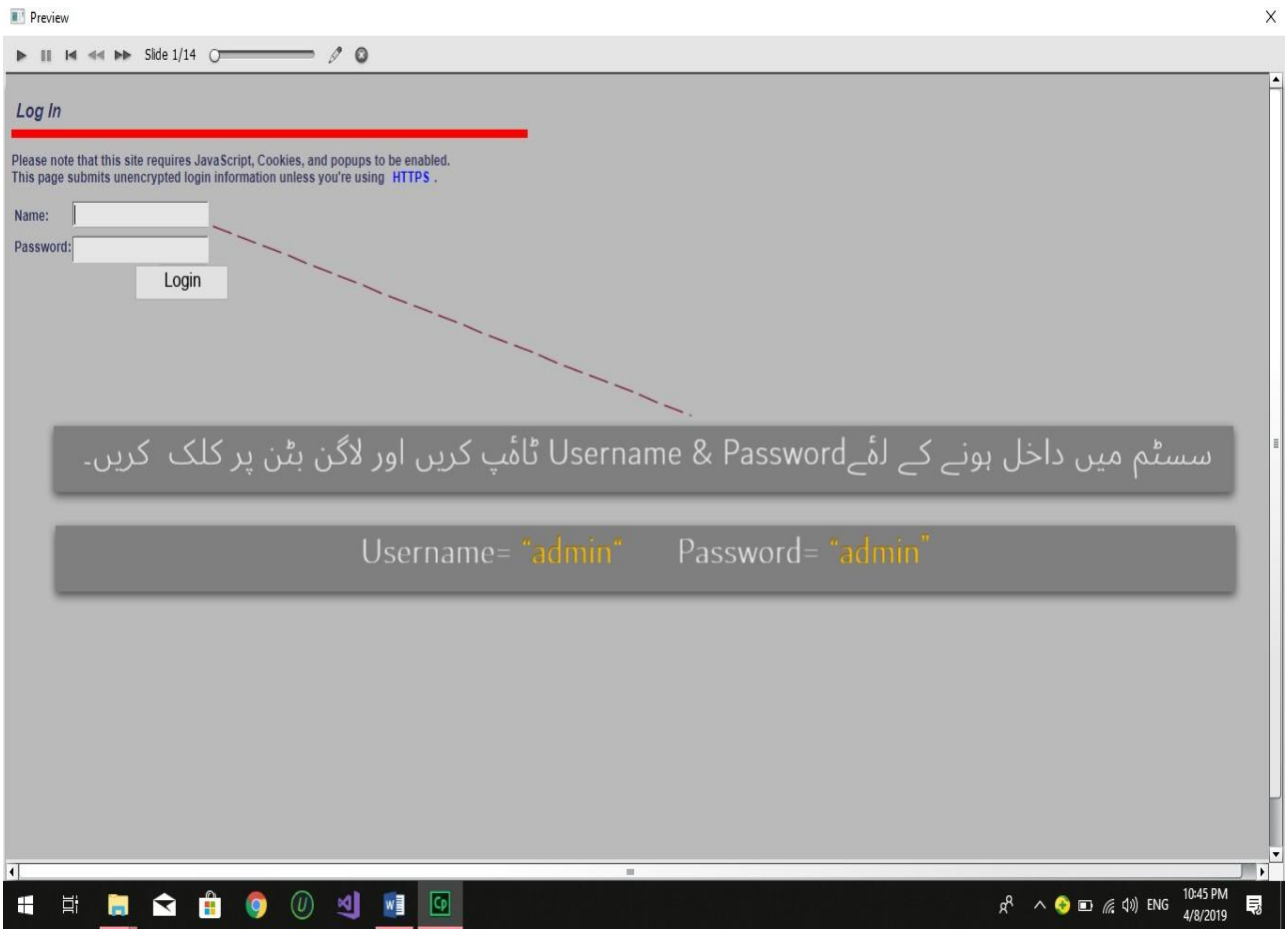
Test Case Number	04
Test Case Name	TNAC module
Description	Press TNAC button to for display of SDR module
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on " TNAC " Button
Steps	• Run the application • Login page is open. • Enter password. • Click on SDR button.
Expected output	TNAC page is displayed.
Actual output	Page displayed with TNAC functionalities.
Status	Test case passed successfully.

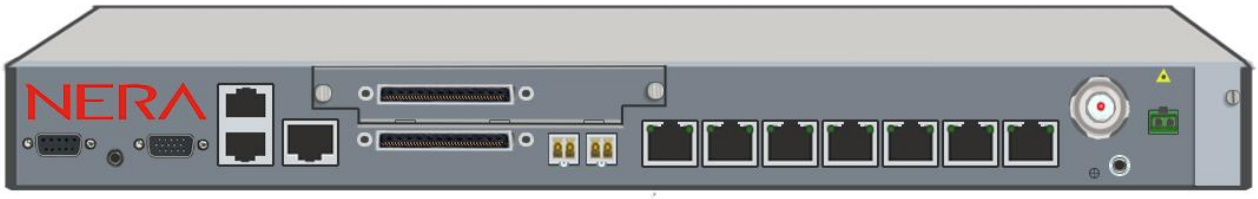
Test Case Number	05
Test Case Name	HARRIS module
Description	Press HARRIS button to for display of SDR module
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on " HARRIS " Button
Steps	• Run the application • Login page is open. • Enter password. • Click on HARRIS button.
Expected output	HARRIS page is displayed.
Actual output	Page displayed with sub applications.
Status	Test case passed successfully.



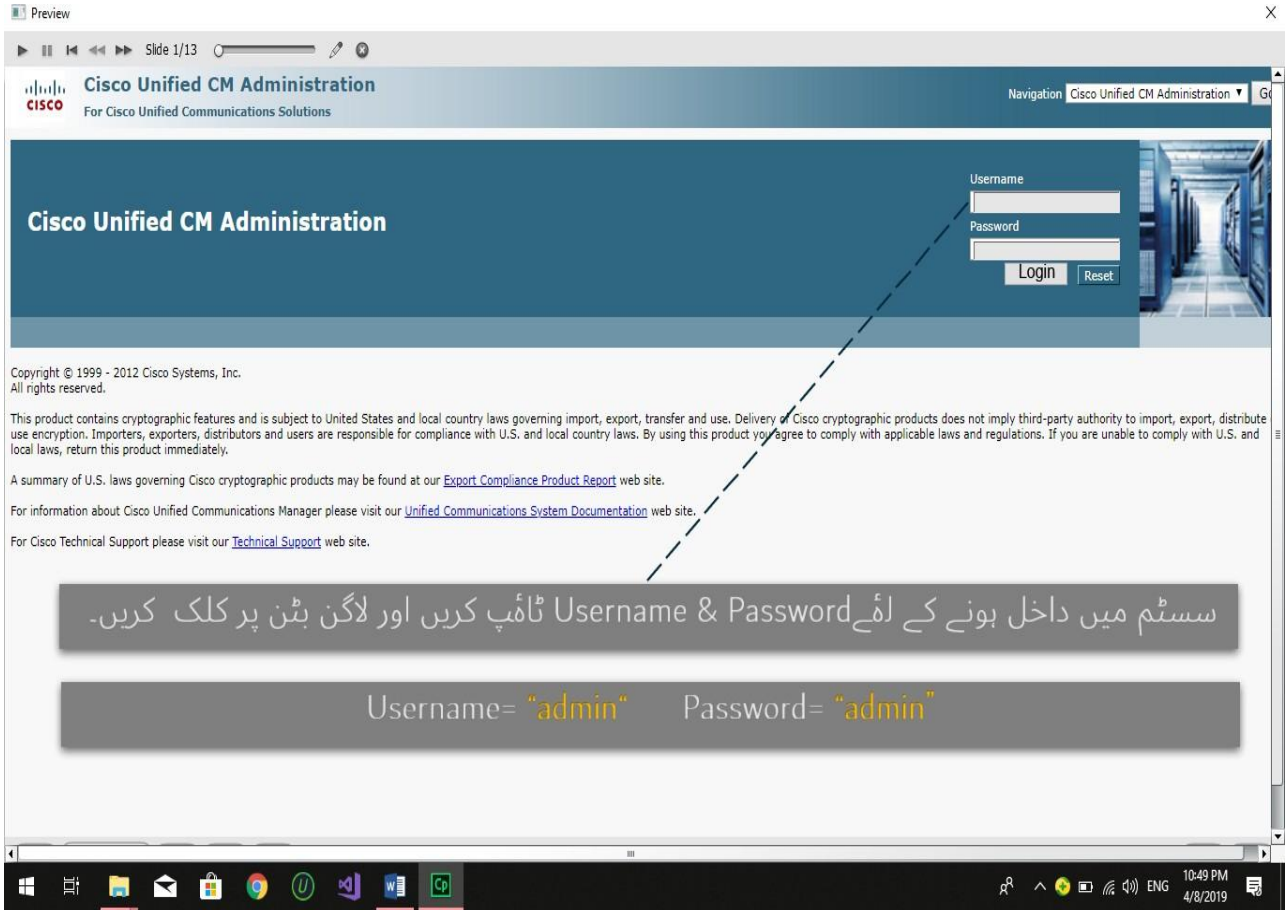
Test Case Number	06
Test Case Name	IP NERA module
Description	Press IP NERA button to for display of M3TR module
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on " M3TR " Button
Steps	• Run the application • Login page is open. • Enter password. • Click on IP NERA button.
Expected output	M3TR page is displayed.
Actual output	Page displayed with sub applications.
Status	Test case passed successfully.

Test Case Number	07
Test Case Name	WMT module
Description	Press WMT button display of NIU Tutorial module
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on " WMT " Button
Steps	• Run the application • Login page is open. • Enter password. • Click on NIU button • Enter IP address of NIU.
Expected output	WMT page should be displayed.
Actual output	Page displayed
Status	Test case passed successfully.



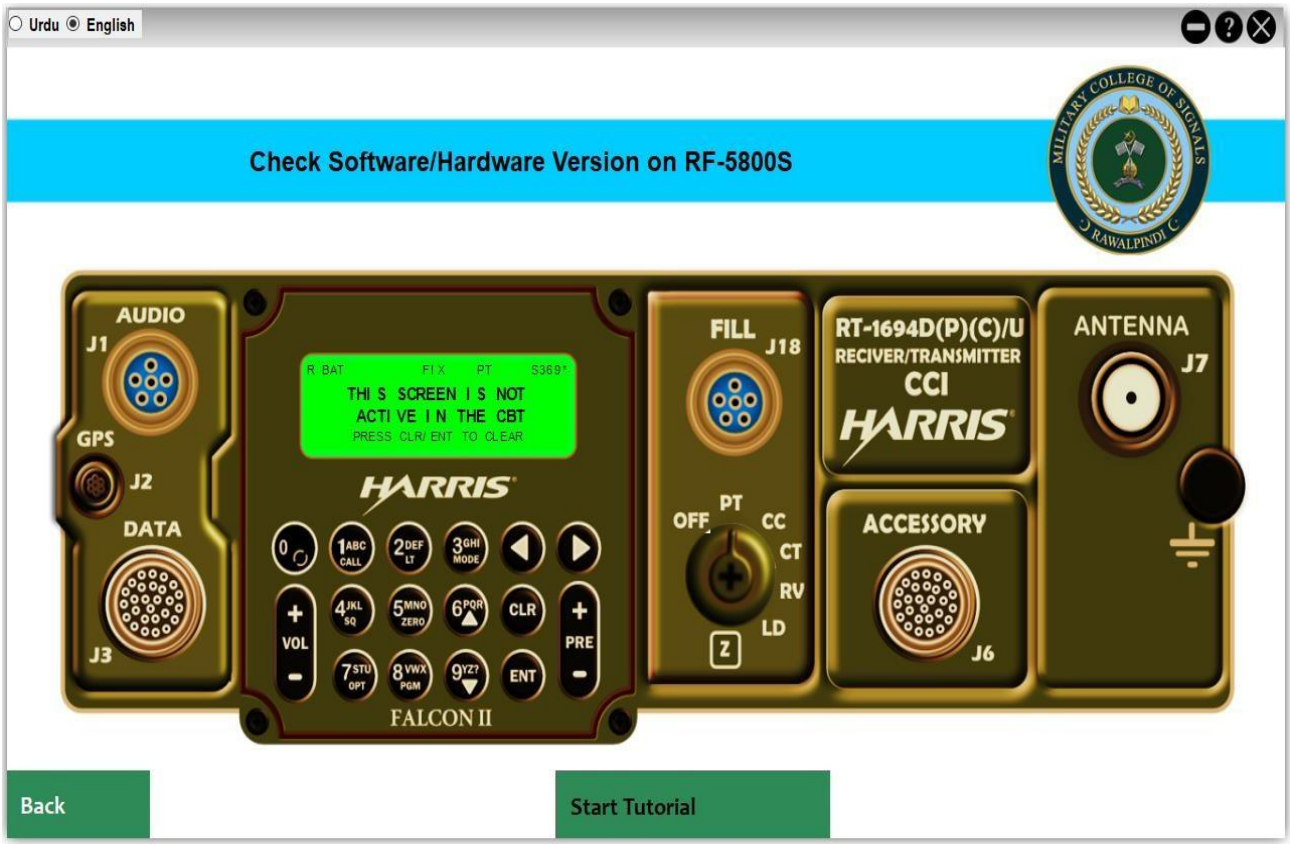

NERA

Test Case Number	08
Test Case Name	NGPATCOM – CUCM module
Description	Press CUCMbutton displaying of CUCM module
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on " CUCM " Button
Steps	• Run the application • Login page is open. • Enter password. • Click on CUCM button.
Expected output	Tutorial page should be displayed.
Actual output	Tutorial Page displayed with CUCM tutorial.
Status	Test case passed successfully.



Test Case Number	09
Test Case Name	Output –HARRIS
Description	HARRIS module will display output for desired action related to functioning of module which is based on random testing of SDR functions.
Testing Technique	Unit testing, Random testing Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on HARRIS button
Steps	• Run the application • Login page is open. • Enter password. • Click on HARRIS button. • Click on send message
Expected output	HARRIS should be displayed with message tutorial.
Actual output	HARRIS message displayed with tutorial.
Status	Test case passed successfully.

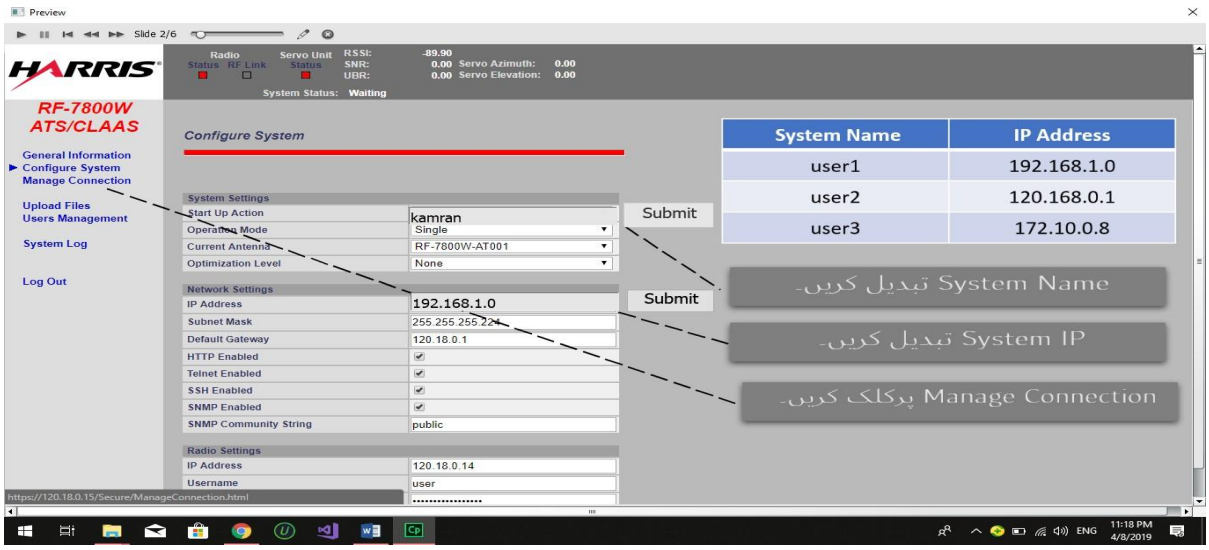
Test Case Number	10
Test Case Name	Output –HARRIS
Description	HARRIS module will display output for desired action related to functioning of module which is based on random testing of SDR .
Testing Technique	Unit testing, random testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on HARRIS button
Steps	• Run the application • Login page is open. • Enter password. • Click on HARRIS button. • Click on check hardware version of RF-5800 • Click next button on module • Click enter
Expected output	Screen should display with RF-5800
Actual output	Screen displayed.
Status	Test case passed successfully.

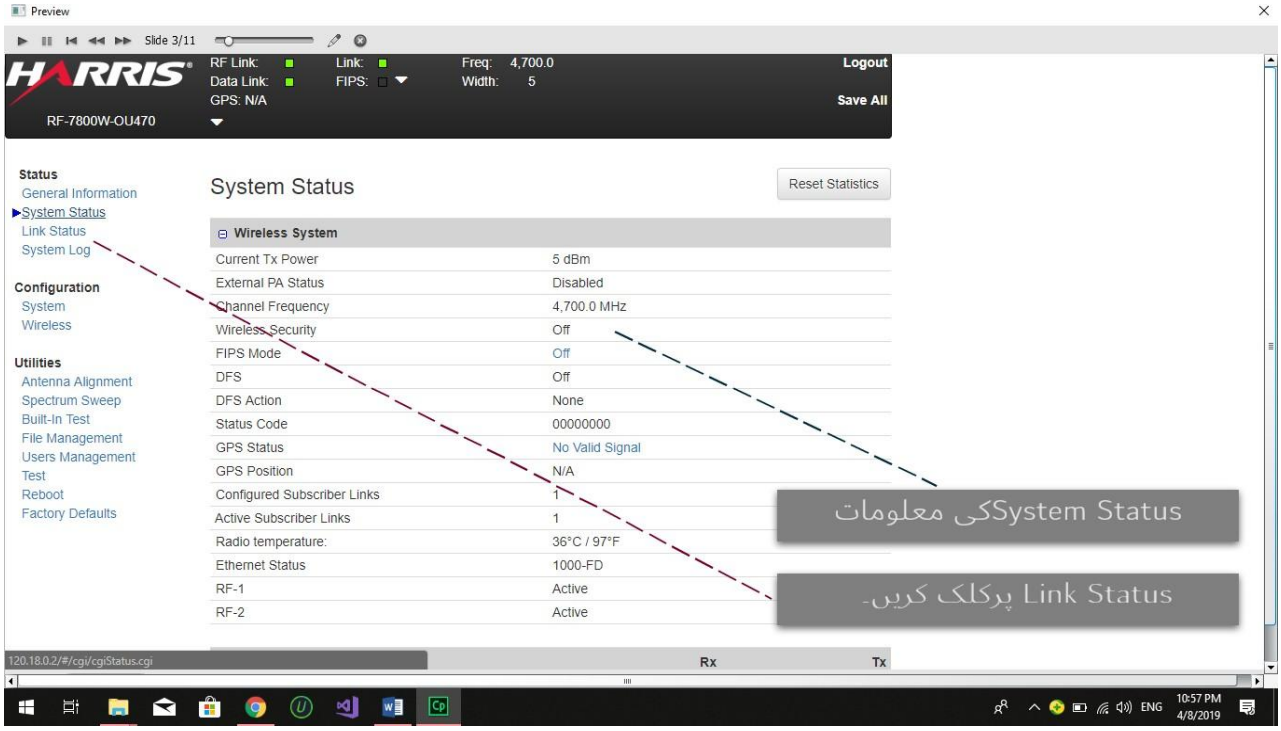


Test Case Number	11
Test Case Name	Output –HARRIS
Description	HARRIS module will display output for desired action related to functioning of module which is based on random testing of SDR .
Testing Technique	Unit testing, random testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on HARRIS button
Steps	• Run the application • Login page is open. • Enter password. • Click on HARRIS button. • Click on Hope Radio Function • Click on audio to fix Antenna
Expected output	Screen should display the fixture of Antenna

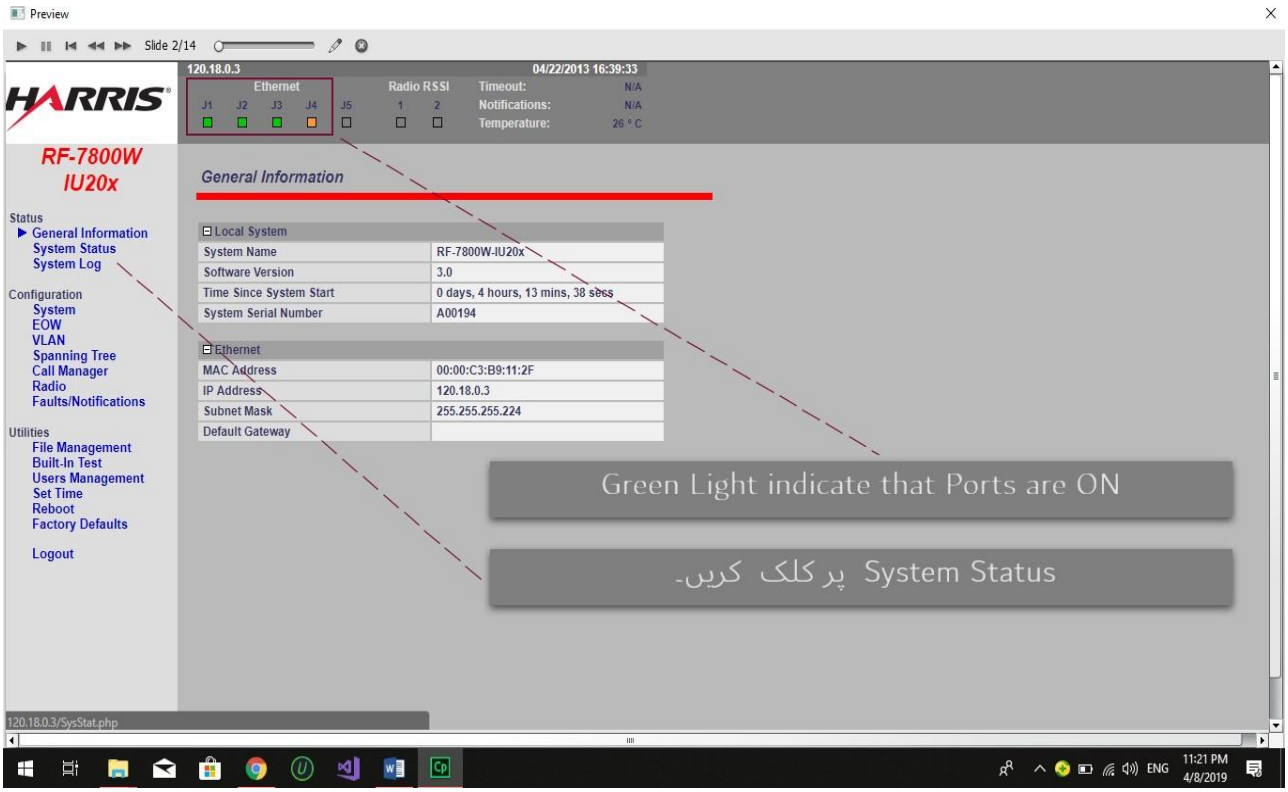
Actual output	Screen displayed.
Status	Test case passed successfully.

Test Case Number	12
Test Case Name	Output – WMT
Description	HCLOS module will display output for desired action related to functioning of module which is based on random testing
Testing Technique	Unit testing, random testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on HARRIS WMT button
Steps	• Run the application • Login page is open. • Enter password. • Click on WMT button. • Enter WMT Login credentials • Click on system status
Expected output	Screen should display system information
Actual output	Output displayed
Status	Test case passed successfully.

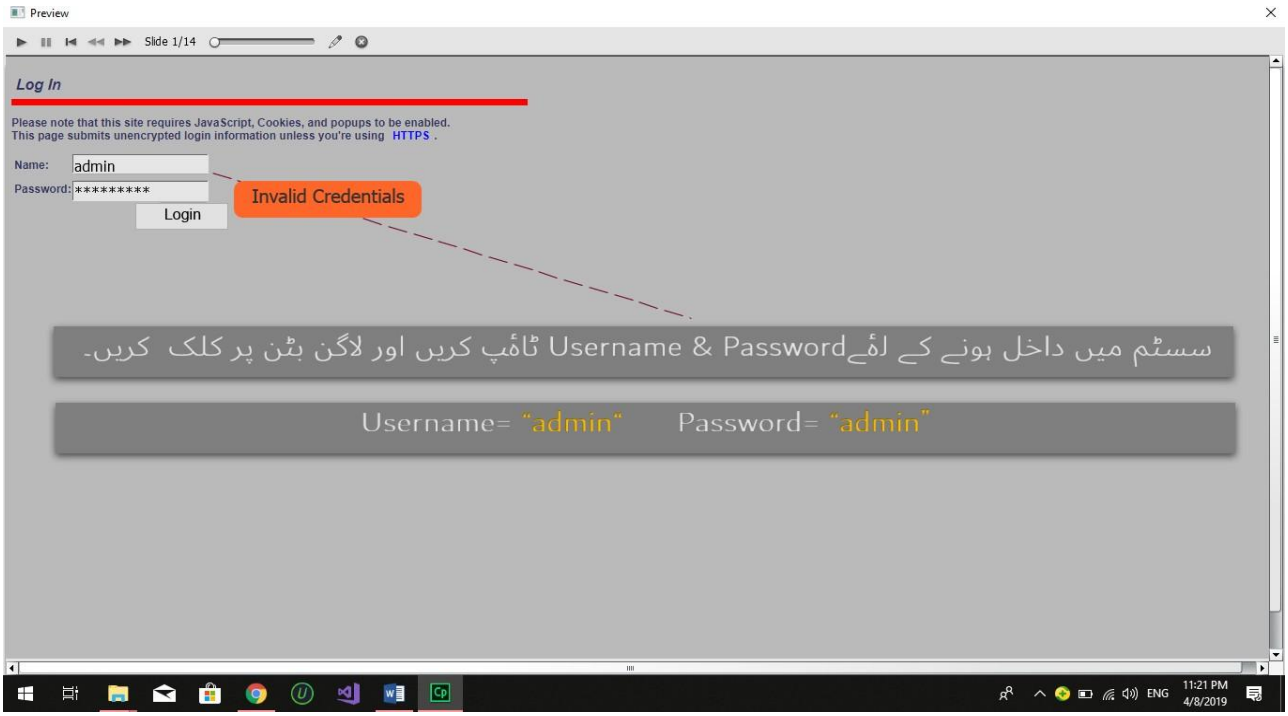

Preview
Slide 2/6
HARRIS
RF-7800W
ATS/CLAAS
Radio
Status RF Link
Servo Unit
Status
RSSI: -89.90
SNR: 0.00
UBR: 0.00
Servo Azimuth: 0.00
Servo Elevation: 0.00
System Status: Waiting
General Information
Configure System
Manage Connection
Upload Files
Users Management
System Log
Log Out
Configure System
System Settings
Start Up Action
Operation Mode
Current Antenna
Optimization Level
kamran
Single
RF-7800W-AT001
None
Submit
Network Settings
IP Address
Subnet Mask
Default Gateway
HTTP Enabled
Telnet Enabled
SSH Enabled
SNMP Enabled
SNMP Community String
192.168.1.0
255.255.255.224
120.18.0.1
public
Submit
Radio Settings
IP Address
Username
120.18.0.14
user
https://120.18.0.15/Secure/ManageConnection.html
System Name
IP Address
user1
192.168.1.0
user2
120.168.0.1
user3
172.10.0.8
System Name تبدیل کریں۔
System IP تبدیل کریں۔
Manage Connection پرکلک کریں۔
ENG
11:18 PM
4/8/2019


Preview
Slide 3/11
HARRIS
RF-7800W-OU470
RF Link:
Data Link:
GPS: N/A
Link:
FIPS:
Freq: 4,700.0
Width: 5
Logout
Save All
Status
General Information
System Status
Link Status
System Log
Configuration
System
Wireless
Utilities
Antenna Alignment
Spectrum Sweep
Built-In Test
File Management
Users Management
Test
Reboot
Factory Defaults
System Status
Reset Statistics
Wireless System
Current Tx Power 5 dBm
External PA Status Disabled
Channel Frequency 4,700.0 MHz
Wireless Security Off
FIPS Mode Off
DFS Off
DFS Action None
Status Code 00000000
GPS Status No Valid Signal
GPS Position N/A
Configured Subscriber Links 1
Active Subscriber Links 1
Radio temperature: 36°C / 97°F
Ethernet Status 1000-FD
RF-1 Active
RF-2 Active
Rx
Tx
120.18.0.2/#/cgi/cgiStatus.cgi
System Statusکی معلومات
Link Status پرکلک کریں۔
ENG
10:57 PM
4/8/2019

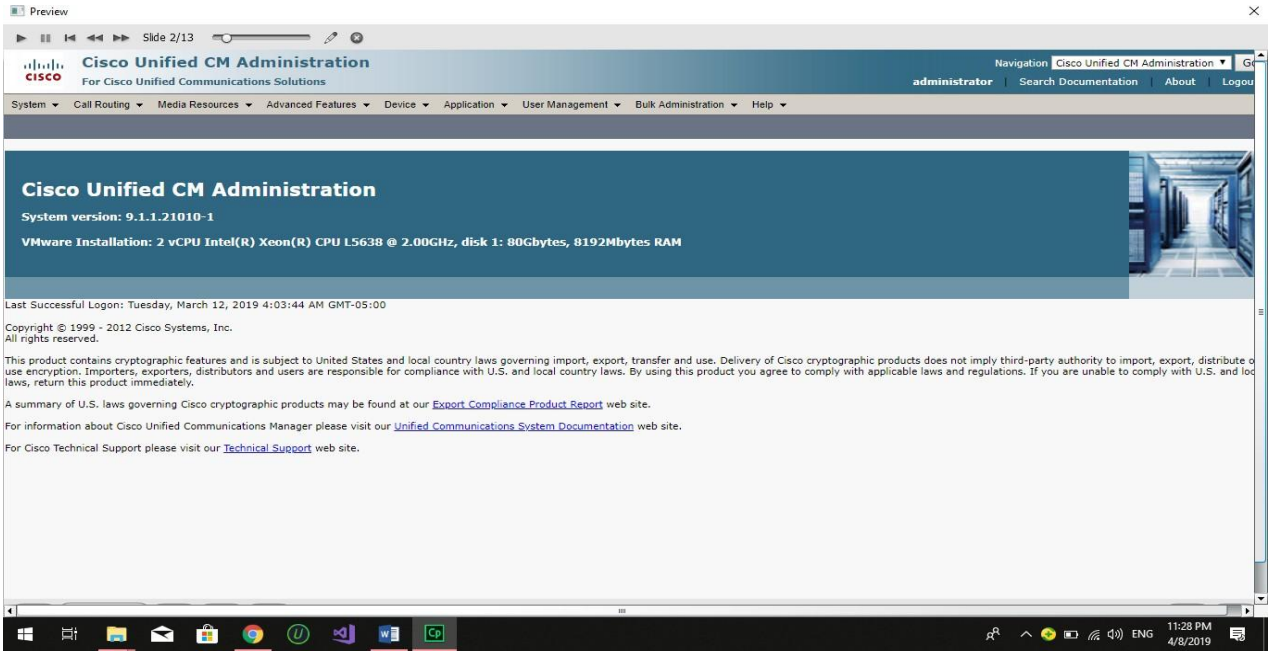
Test Case Number	13
Test Case Name	Output –NGPATCOM-NIU
Description	NIU module will display output for desired action related to functioning of module which is based on unit testing.
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on NIU button
Steps	• Run the application • Login page is open. • Enter password. • Click on NIU button. • Enter Login Credentials. • Click stepwise subsequent functions
Expected output	Screen should display the web interface of NIU with further subsequent functions.
Actual output	NIU web interface opened
Status	Test case passed successfully.


Preview
Slide 2/14
120.18.0.3
04/22/2013 16:39:33
Ethernet
J1 J2 J3 J4 J5
Radio RSSI
1 2
Timeout: N/A
Notifications: N/A
Temperature: 26 ° C
RF-7800W
IU20x
General Information
Status
General Information
System Status
System Log
Configuration
System
EOW
VLAN
Spanning Tree
Call Manager
Radio
Faults/Notifications
Utilities
File Management
Built-In Test
Users Management
Set Time
Reboot
Factory Defaults
Logout
Local System
System Name RF-7800W-IU20x
Software Version 3.0
Time Since System Start 0 days, 4 hours, 13 mins, 38 secs
System Serial Number A00194
Ethernet
MAC Address 00:00:C3:B9:11:2F
IP Address 120.18.0.3
Subnet Mask 255.255.255.224
Default Gateway
Green Light indicate that Ports are ON
System Status پر کلک کریں۔
120.18.0.3/SysStat.php
ENG
11:21 PM
4/8/2019

Test Case Number	14
Test Case Name	Output –NGPATCOM-NIU
Description	NIU module will display output for desired action related to functioning of module which is based on random testing
Testing Technique	Unit testing, random testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on NIU button
Steps	• Run the application • Login page is open. • Enter password. • Click on NIU button. • Click on practice. • Enter incorrect address(120.18.0.20)
Expected output	Screen should not display the web interface of NIU.
Actual output	NIU web interface not opened
Status	Test case passed successfully.



Test Case Number	15
Test Case Name	Output –NGPATCOM-CUCM
Description	CUCM module will display output for desired action related to functioning of module which is based on unit testing
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application is running with authentic login
Input Values	Click on CUCM button
Steps	• Run the application • Login page is open. • Enter password. • Click on CUCM button • Enter Login Credentials. • Click stepwise subsequent functions
Expected output	Screen should display CUCMinterface with stepwise subsequent functions.
Actual output	CUCMinterface opened.
Status	Test case passed successfully.



Responsibilities, Staffing and Training Needs

4.6 Responsibilities:

All developers of the project are responsible for the completion of all components testing and integration testing tasks.

4.7 Staffing and Training Needs:

Basics knowledge of testing strategies and techniques is needed for the testing of the project. Techniques such as Black Box testing, integration testing should be known to developers.

All the developers will be testing each other's work and will be actively participating in the development and testing of the project simultaneously.

Schedule

4.8 Important Dates

- Unit testing and integration testing will be finished by the start of first week of April 2020.
- Acceptance Testing will be performed right after the Development process completed i.e. 2nd week of April 2020.

Risk and Contingencies

4.9 Schedule Risk:

The project might get behind schedule so in order to complete the project in time we will need to increase the hours/day that the project is being worked on.

4.10 Operational Risks:

Operational risks will be eliminated by Scheduling daily meetings and regular deadlines to meet the goals of the project as well as provide proper communication within the group.

4.11 Technical risks:

Technical risks will be eliminated by keeping the once defined requirements constant.

4.12 Programmatic Risks:

In case of a programmatic risk the scope of the project will be limited in order to stay inside the constraints of the project

CHAPTER # 5

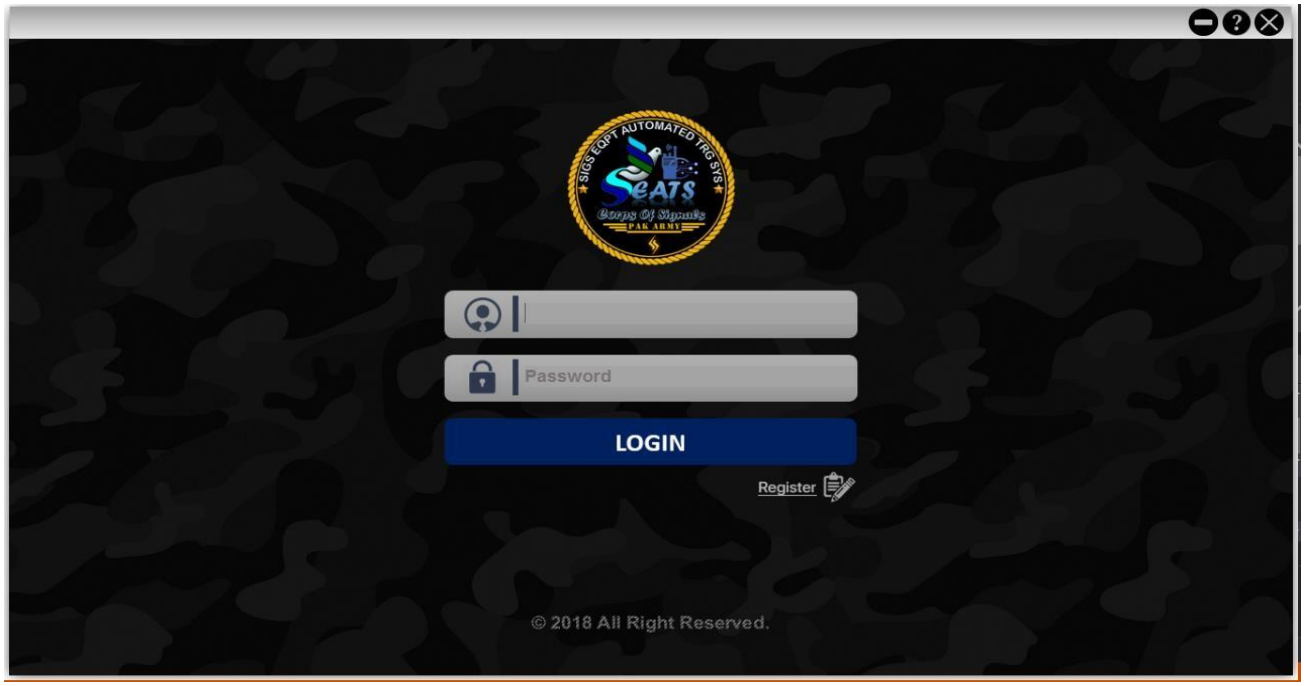
USER MANUAL

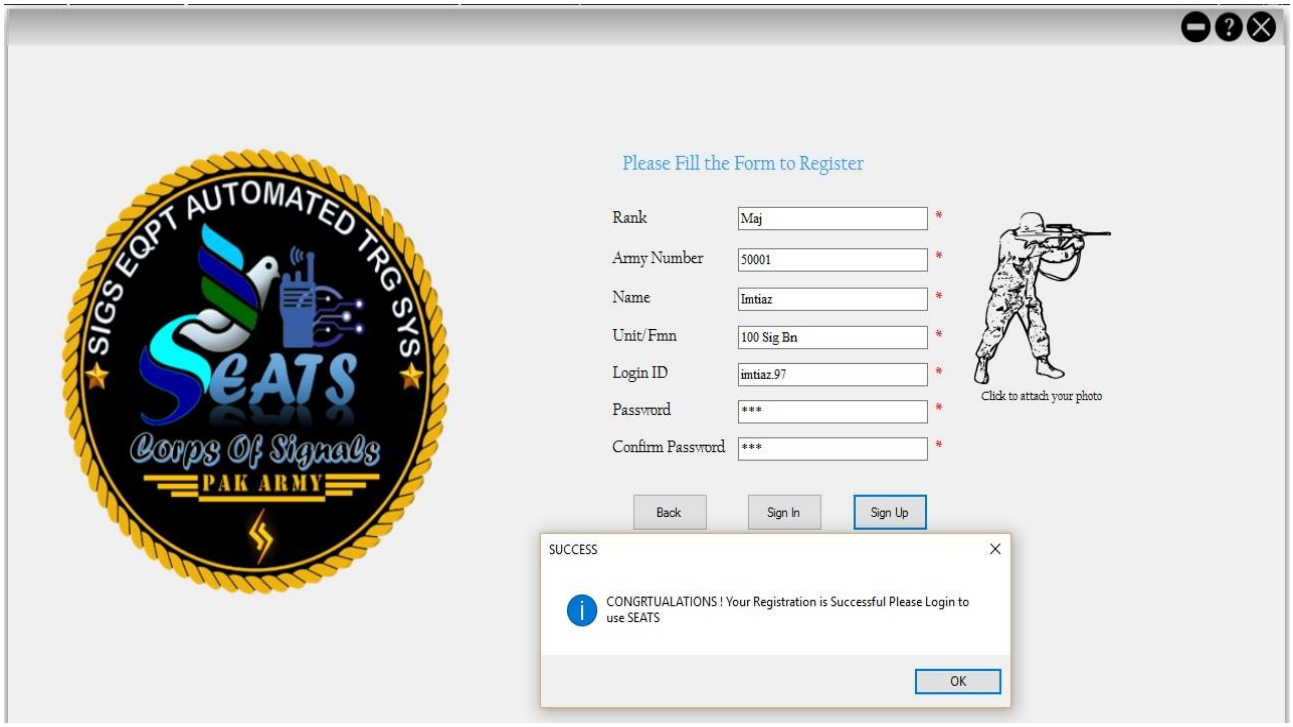
5.1 Introduction

The user guide will give complete description of all the platforms and tools used and how to install the software's needed to develop the application. The main tools used are visual studio, adobe captive.

5.2 Installation and usage Guide

- Before running SEATS software you need to have visual studio software in your laptop or PC with window 7 & above.
- Once you have it then click on run SEATS to launch the application and it will run after compiling the code.
- It is recommended you need to have SSD built in or externally installed as it is a very heavy code with multiple video and user graphics so normal configuration laptop take time delay and usually perform very slow.
- After running normal login page will be displayed in which you have to enter your login details if you are the new users then you need to first register yourself and set your password so that your details are added into that which helps to maintain the data base of the users.

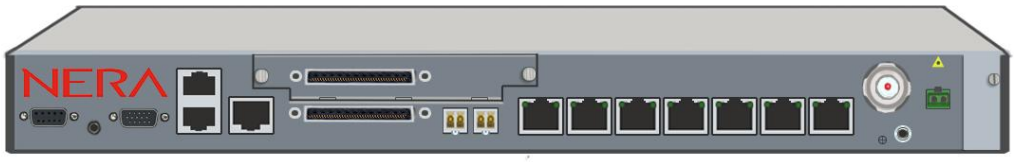

SIGS EQPT AUTOMATED TRG SYS
SEATS
Corps Of Signals
PAK ARMY
Password
LOGIN
Register
© 2018 All Right Reserved.


SIGS EQPT AUTOMATED TRG SYS
SEATS
Corps Of Signals
PAK ARMY
Please Fill the Form to Register
Rank
Maj
Army Number
50001
Name
Imtiaz
Unit/Fmn
100 Sig Bn
Login ID
imtiaz.97
Password
***
Confirm Password
***
Click to attach your photo
Back
Sign In
Sign Up
SUCCESS
CONGRTUALATIONS ! Your Registration is Successful Please Login to use SEATS
OK

- After login the main page is displayed which consist of modules incorporated in SEATS.

- Click on any desired modules which you want to learn if you click on any modules it will guide you automatically which steps you need to follow to learn that particular module.

- For ease of users the language option is also enabled whether it is used by officers or soldiers.



- Voice command is also enabled for further guidance for each steps.
- Mouse options are also included where you need to perform that particular action.

- For HARRIS WMT module follow the steps describe by cursor and the voice command.

- Videos are also incorporated to understand the working of these modules which gives more clarity for practical usage of this suit

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