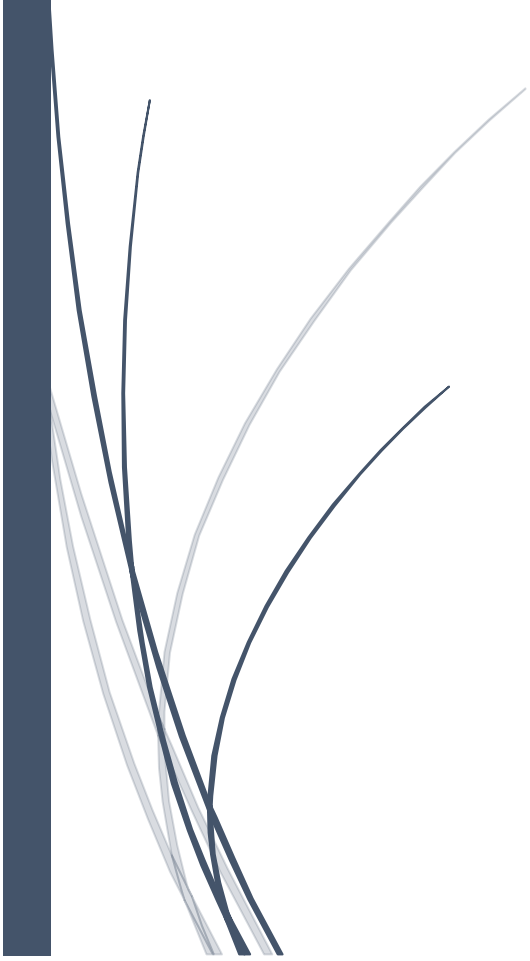
2/1/2017

Nerve Segmentation



Final Year Project

Nerve Segmentation

Team

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2016

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Contents

Introduction

1. Introduction

Even the bravest patient cringes, when he listen about the surgical procedure. Surgery certainly brings discomfort and mostly involves substantial post-surgical pain. The pain is usually managed by the use of narcotics. But those narcotics brings a lot of side effects with them.

A better method to manage the pain is the use of indwelling catheters that reduce the pain at the source. Catheters reduce the patient dependence on narcotics and speed up patient recovery.

The problem that doctors face during the placement of pain management catheter, is the identification of the nerve segmentation. Doctors use the ultrasound images of pain source to identify the nerve segmentation manually, but this method is time consuming.

So this project aims to identify that nerve segmentation by applying different machine learning techniques on the ultrasound images of the pain source. This methods increases accuracy and reduces the time. It will be a great relief for the doctors.

Literature Review

2- Literature Review

We have studied two research papers related to image segmentation and the outcome are as follows:

FCNN for Semantic Segmentation:

Model consisting of 45 layers requiring around 8 GB of GPU memory. It was tested on several competitions giving promising results. Its results on their dataset were good, so we decided to try their models on our dataset.

UNET for Bio-medical Image Segmentation:

This model has 9 layers. It was also giving promising results and was much related to our project. So we decided to continue using it instead of the previous model, because training of our dataset on such a huge network would require more resources and was also time consuming.

Project Vision

3. Project Vision

Vision of this project is to develop a unique system, which will help a doctor in the identification of nerve segmentation accurately and better placement of pain management catheter. Which helps to reduce the patient's post-surgical pain.

3.1. Problem Description

Surgical procedure leads to post-surgical pain. There are two methods to manage the pain:

1. Usage of narcotics
    - This method have a lot of side effects.
2. Usage of pain management catheters
    - This method is far better than the previous one, because it reduces the patient's dependency on narcotics and helps to speed up patient's recovery.

Usage of catheters is a good method, but it is time consuming and requires a great deal of expertise to identify the nerve segmentation.

3.2. Business Opportunity

Day by day the world is moving towards automation, because automation saves time and reduces human error. As this project speed up the process of identification of nerve structure, so it will be really valued by the doctors and hospitals. So this project has a huge market waiting for it.

3.3. Objectives

This project objective are:

1. To identify nerve structure from ultrasound images.
2. To reduce patient's post-surgical pain.
3. To save doctor's time, that he spends on nerve structure identification.
4. To reduce the human error in nerve structure identification.
5. To place the pain management catheters at the accurate position.

3.4. Project Scope

Design and development of a web and mobile application for the identification nerve structure from the ultrasound images of the neck.

3.5. Constraints

Project constraints are:

Data Constraints:

1. Project scope is confined to just neck ultrasound images, due to the data availability.

Computational Constrains:

2. Project requires high end GPU for the processing and training of data.
3. Project requires 24/7 availability of server to serve user queries.

3.6. Stakeholders Description

Stakeholders involve in project are:

Doctors:

They will upload the image to our product/software and it will return them the image with the tissue identified as white space on that ultrasound image.

Developer:

They will be responsible to maintain and keep the system up to data.

SRS (System Requirements Specification)

4. System Requirements Specification

4.1. List of Features

The list of features is as follows:

1) Central Authentication
2) Database Management
3) Patient History
4) Building Android and Web-based applications
5) Nerve Tissue Identification
    a. Data Acquisition
    b. Image enhancement
    c. Spatial Transformations
    d. Training of System

4.2. Functional Requirements

1) System should be able to classify pictures.
2) System should be able to pre-process on data Images.
3) System should be able to let the user upload images only in valid format.
4) System should be able to show the proper error messages to the user when input is not valid.
5) System should be able to show the list of uploaded images to the user.
6) System should be able to manage patient record.
7) System should be able to show the patient record/ Medical status.
8) System should be able to manage feedbacks given on a picture.
9) System should be able to generate desired results.

4.3. Quality Attributes

The following are the quality attributes we will work on and will want to assure them that they are present there in our system.

4.3.1. Reliability

The system will not crash on invalid data/Input. The data files will be stored on a nonvolatile storage device such as a hard drive, so that the data files can be retained when the system is shut off. The system will check the validity of the user data. If there is an error the system will ask the user to login again or move to last entry in the log file. If there is a fatal error the system shuts down without crashing the computer it is running on.

4.3.2. Availability

The system will only run infrequently. The system will allow the user to restart the application after a crash. All data beyond the last save point will be lost. The user will be able to load his or her data file after the system has been restarted and continue using the system. The system will have an average run time of 15 to 20 min per session depending on the user, although the user may use the system longer.

4.3.3. Security

The system will use the computer's default operating system security. The system will use SSL security features since the software is web-based and it is going to be run over a network. The system will be contained on network of computers. The data files will not be encrypted since the data stored in these files should be easily modifiable and readable in case the system is used for research. The system checks the validity of the data files when it is running and if the data is invalid the system outputs an error to the user. The system will keep log files of the Users activity expect their usage.

4.3.4. Maintainability

The Technical Support Personal will be able to update the system with new content and data files. The system will ask the user to specify a directory where the data will be stored. The corresponding data file will contain information about the log of the Users activities. The product will be built using components that are as independent as possible to make the system easily modifiable. All components of the system will be modular and be as independent as possible. db_Admin will be able to add new Users.

4.3.5. Portability

The product will be able to run on Windows/Ubuntu. The software will be written in a platform independent programming language for portability; there will be no platform specific code. We will

write all the software using Python. We will use the Django Framework for web and Java GUI Framework for android for the support of the GUI and front ends. The system's data files will be portable between different Window Versions and different Linux Versions.

4.4. Non-Functional Requirements

4.4.1. Security Requirements

The system shall not be used without the authentication of the valid users i.e. Doctors and Assistants. The users must provide some specific details to login to the system. The doctors/Assistants would login by providing their username and password.

4.4.2. Software Quality Attributes

The different information saved through the system must be saved in the database as well so that there is no repetition in the data i.e. when the information is required at various points the system should not ask for that information to be entered again. Thus, the system should automatically fill in the required details from the database. This would provide reusability, flexibility and maintainability in the system.

4.4.3. Performance Requirements

The system shall perform smoothly when a doctor/user is using it. The system should be able to perform smoothly for which we will have to take care of the server that the server runs smoothly and has limited number of connections to it.

High Level Use-Cases

5. High Level Use-Cases

5.1 Use Cases:

1) Sign In
2) Sign Up
3) Edit Personal Information
4) Identification of Nerve tissue

Use Case UC-01: Sign In
Actor: Doctor
Input: Doctor Account information

Type: Primary

Doctor will insert his account information to sign in into the system in order to use the system.

Use Case UC-02: Sign Up**:**
Actor: Doctor
Input: Doctor personal information

Type: Primary

Doctor will insert his personal information in order to get register into the system.

Use Case UC-03: Edit Personal Information**:**
Actor: Doctor
Input: Updated info

Type: Primary

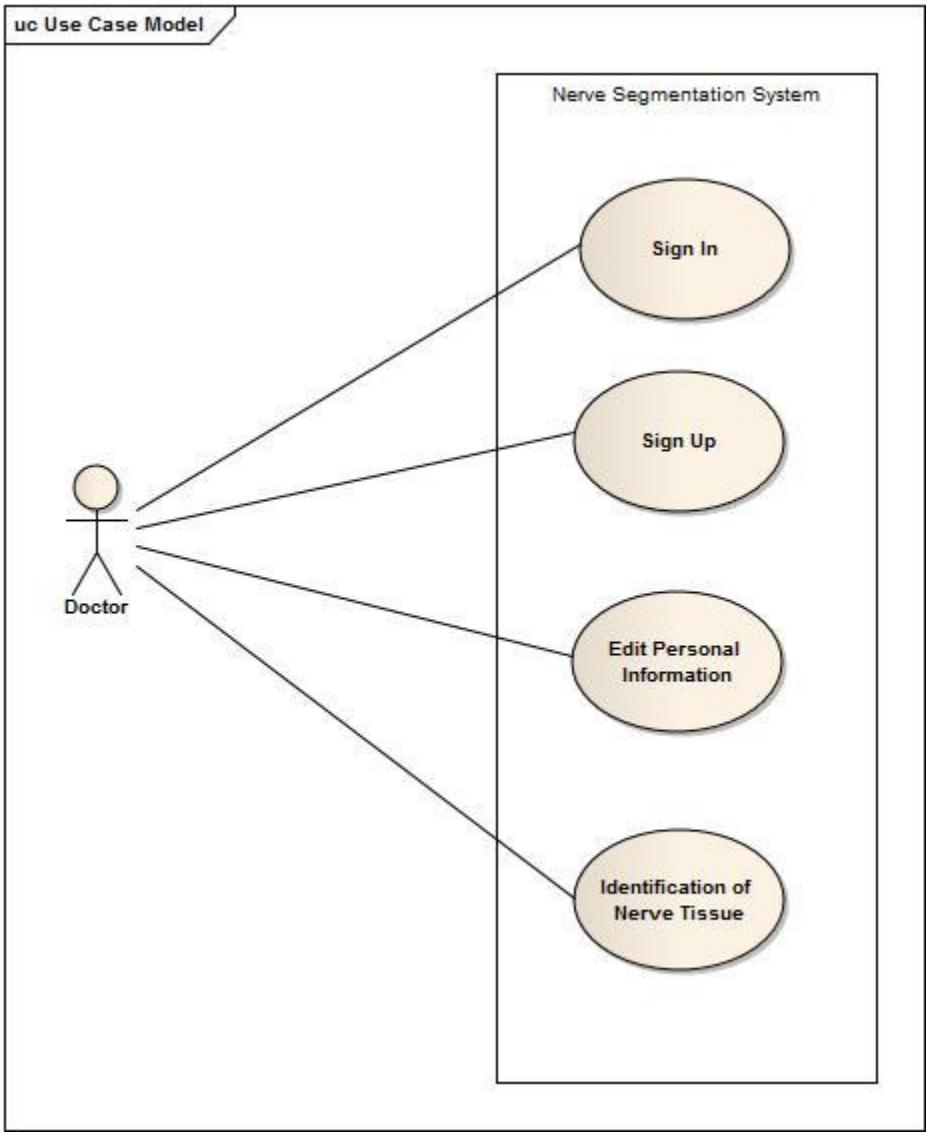
Doctor will insert his new updated personal information into the system to keep his personal information updated in the system.

Use Case UC-04: Identification of Nerve Tissue**:**
Actor: Doctor
Input: Ultrasound Image

Type: Primary

Doctor will upload an ultrasound image into the system, the system will process that image and return an image which will display the nerve tissue.

5.2 Use Case Diagram:



5.3. Expanded Use Cases

5.3.1. UC-01

Scope:
Ultrasound Nerve-Segmentation System
Use Case:
Sign In
Actors:
Doctor
Level:
User goal
Pre conditions:
Doctor must have already sign up in the system
Post conditions:
System generates session id for Doctor and maintains.

Main Success Scenario:

Primary Actors Actions	System Response
1- Doctor will enter his account information	2- System will validate his account information

Extensions / Alternative Flow

Step2:
If account related to the information is not found in the system database then the system will take the doctor to *Step 1.*

Frequency of Occurrence:

Whenever doctor wants to login in the system.

5.3.2. UC-02

Scope:
Ultrasound Nerve-Segmentation System
Use Case Name:
Sign Up
`
Actors:
Doctor
Level:
User goal
Pre conditions:
Doctor must visit the web portal
Post conditions:

Doctor's personal information is added in the system database.

Main Success Scenario:

User Action	System Response
1- Doctor will insert his personal information in to field of the Sign Up page.	2- System will validate the information and create an account related to the information.

Extensions / Alternative Flow

Step 2:
If inserted information is not valid the system take the doctor to Step 1

Frequency of Occurrence:

It will occur whenever doctor creates an account.

5.3.3. UC-03

Scope:
Ultrasound Nerve-Segmentation System
Use Case:
Edit Personal Information.
Actors:
Doctor
Level:
User goal

Pre conditions:
Doctors must be signed in in the system.
Post conditions:
Doctor's updated information will be saved in the system.

Main Success Scenario:

User Action	System Response
1- Doctor will insert his updated information in the fields.	2- System will update that Doctor's personal information in the system.

5.3.4. UC-04

Scope:
Ultrasound Nerve-Segmentation System

Use Case:
Identification of Nerve tissue
Actors:
Doctor
Level:
User goal

Pre conditions:
Doctor must be logged in to the system.

Main Success Scenario:

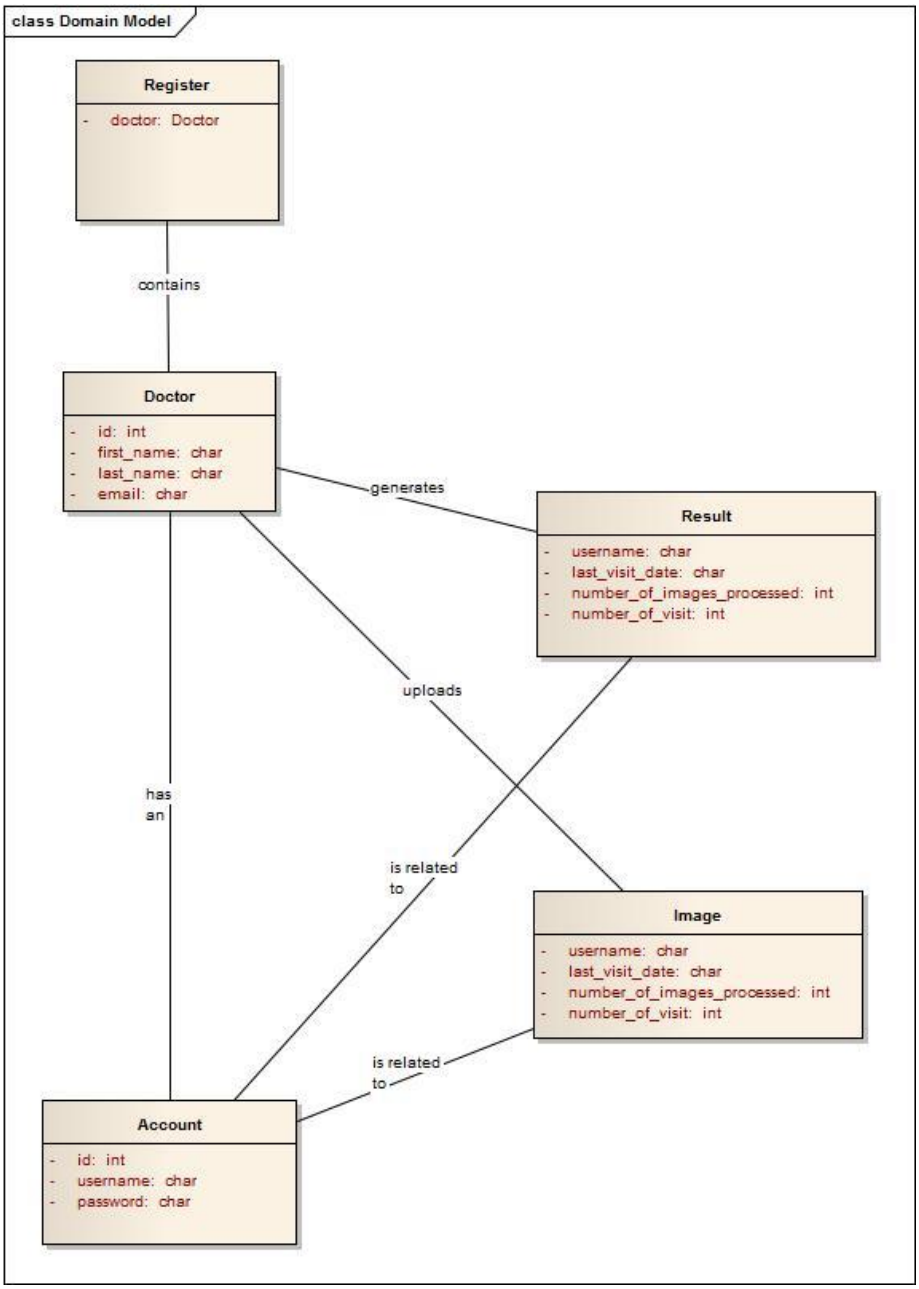
User Action	System Response
1- Doctor will upload an image on the system.	2- System will process the image and display the generated result on the webpage.

Extensions / Alternative Flow

Step2:

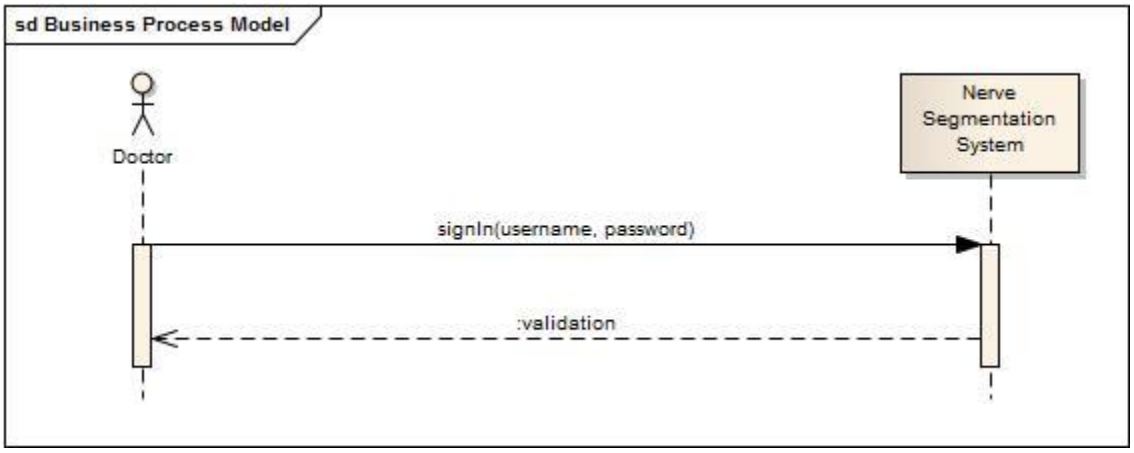
If file that was uploaded by Doctor is not in appropriate format the system will ask the user to enter the image having the appropriate format.

5.4 Domain Model

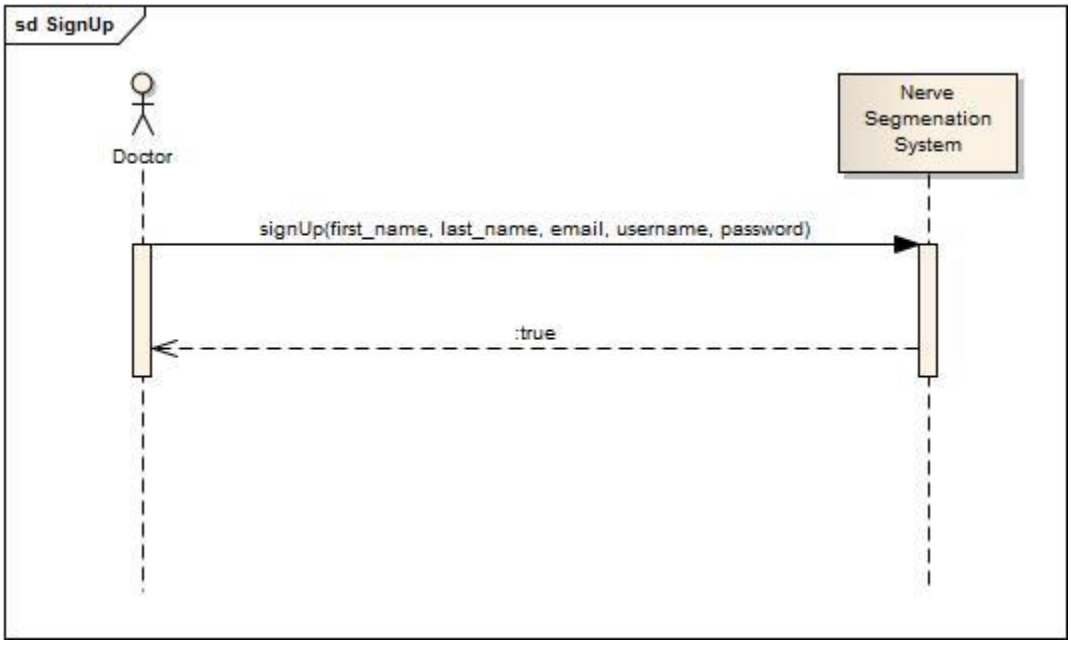


5.5 System Sequence Diagram:

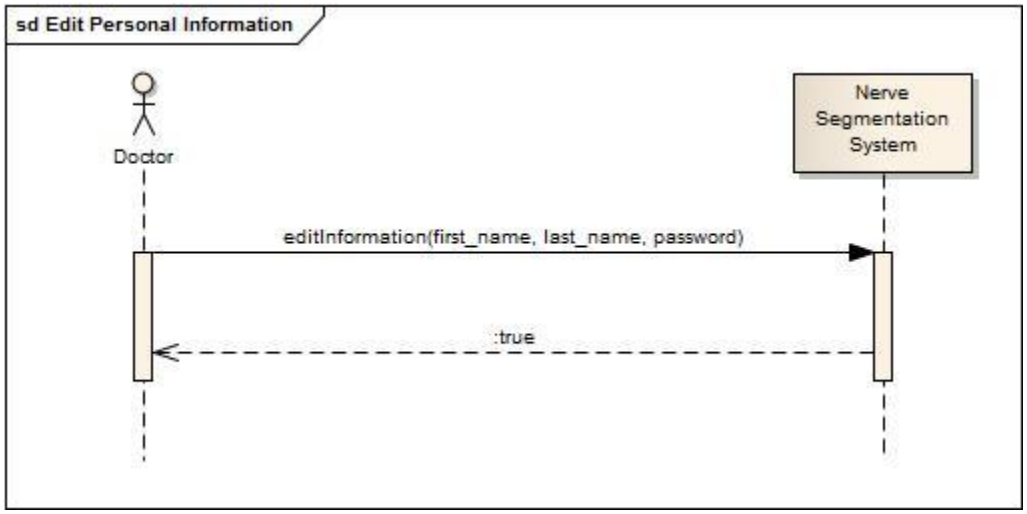
5.5.1 SSD-01 Sign In



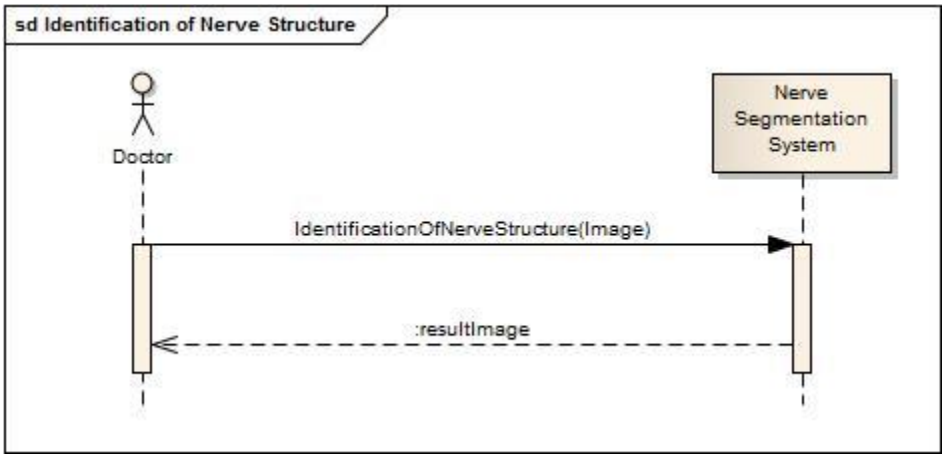
5.5.2 SSD-02 Sign Up



5.5.3 SSD-03 Edit Personal Information



5.5.4 SSD-04 Identification of Nerve Tissue



5.6 Operation Contracts:

5.6.1. OC #1:

Name	SignIn(username, password)
Responsibility	To sign in an user to his account
Type	System
Cross-References	Use-Case: Sign In
Pre-Conditions	NONE
Post-Conditions	Session id was generated and maintained
Exceptions	Invalid username, password

5.6.2. OC #2:

Name	SignUp(first_name, lastname, email, username, password)
Responsibility	To create an account in the system database for a doctor.
Type	System
Cross-References	Use-Case: SignUp
Pre-Conditions	NONE
Post-Conditions	Doctor object was created and added into the system
Exceptions	Invalid input information

5.6.3. OC #3:

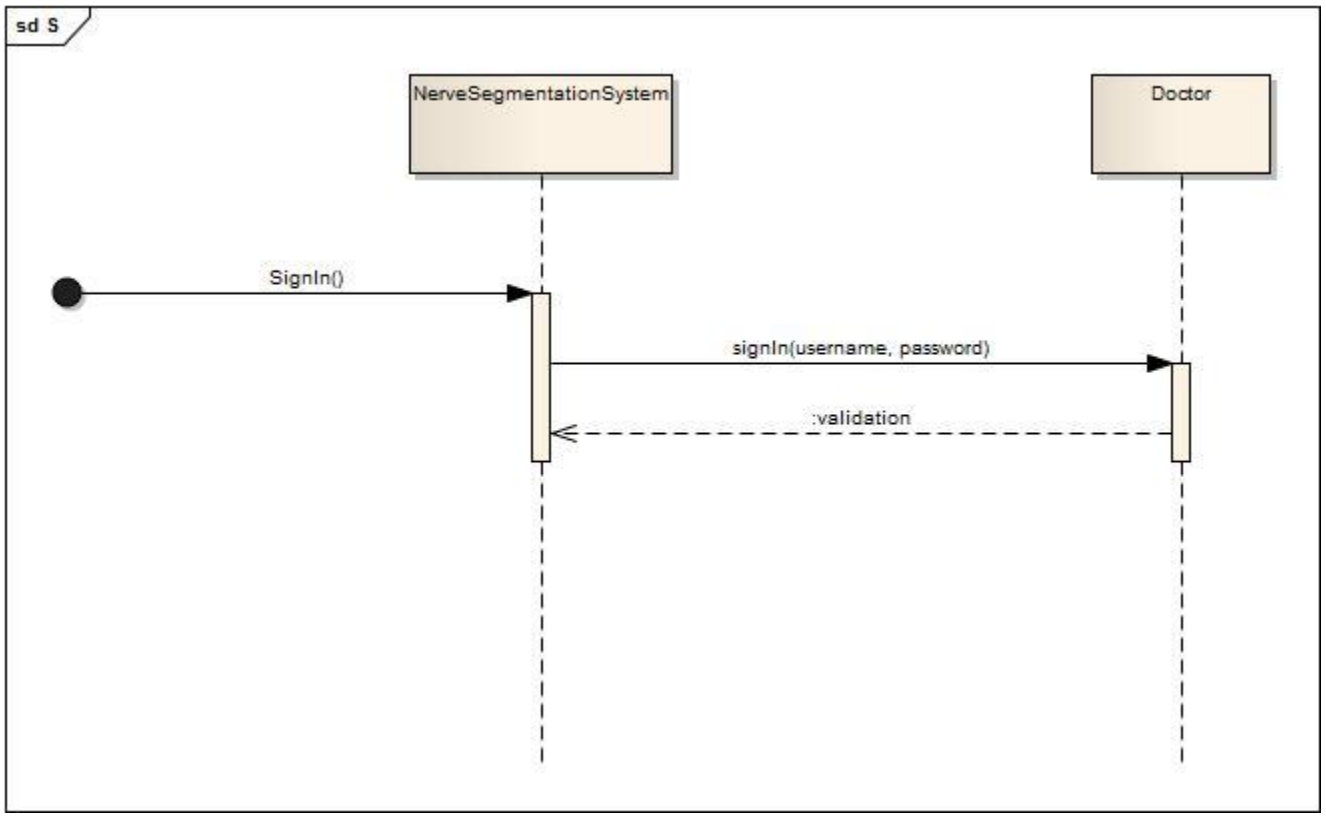
Name	EditPersonalInformation(first_name, last_name, email, password,)
Responsibility	To update the Doctor information in the system database
Type	System
Cross-References	Use-Case: EditPersonalInformation
Pre-Conditions	Doctor session id should be created
Post-Conditions	Attributes if doctor's object was updated and stored in the system
Exceptions	Invalid input account information

5.6.4. OC #4:

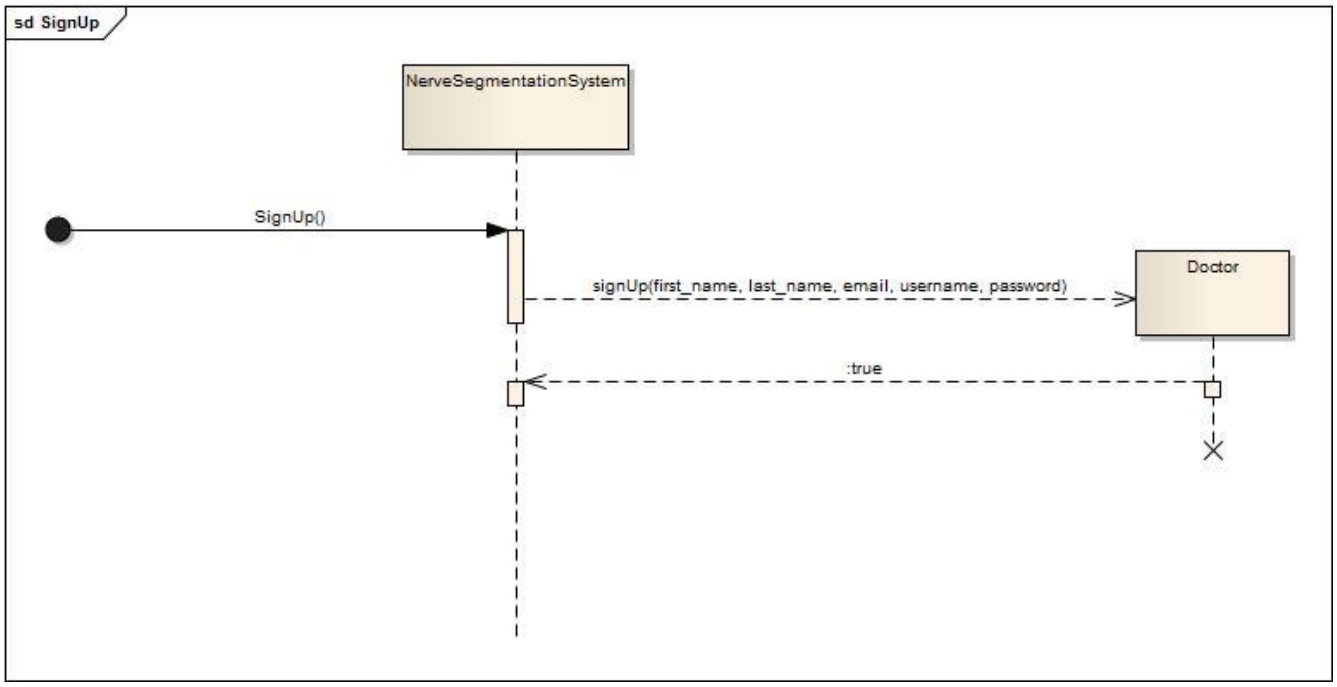
Name	IdentificationOfNerveTissue(Image)
Responsibility	To identify the nerve tissue.
Type	System
Cross-References	Use-Case: Identification of Nerve Tissue
Pre-Conditions	Doctor session id should be created
Post-Conditions	Image and Result object was created and initialized
Exceptions	Image uploaded is not in proper format

5.7 Sequence Diagrams

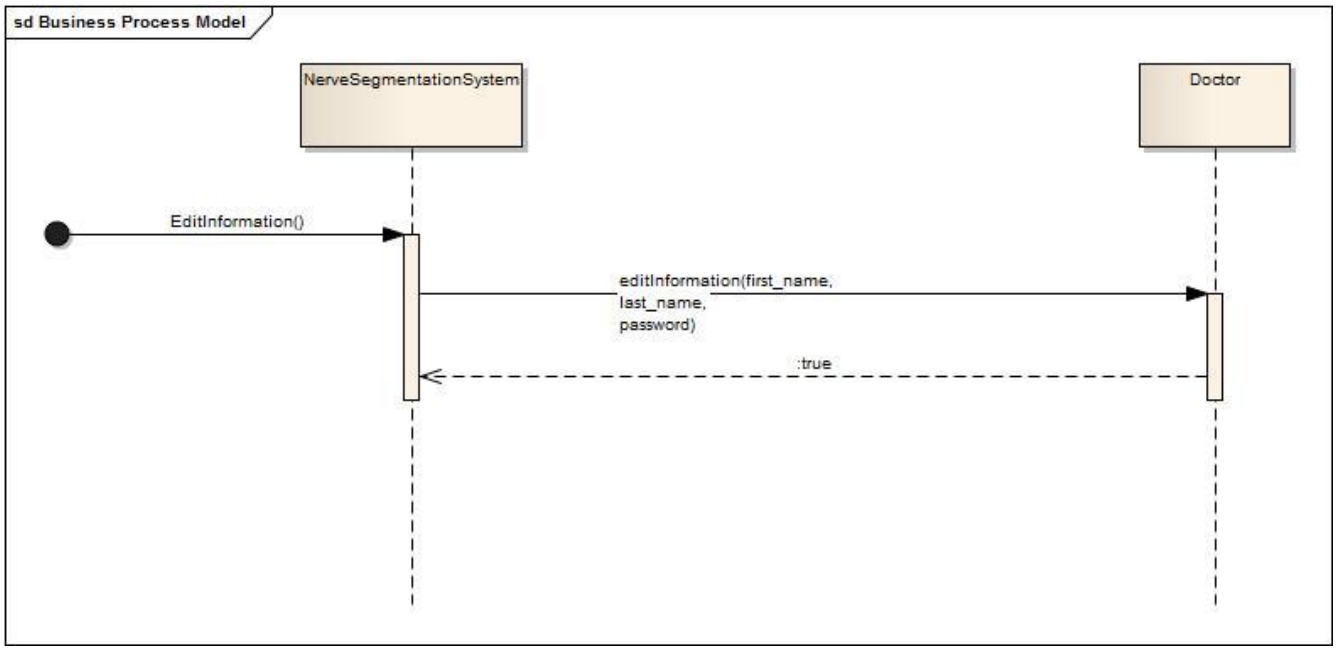
5.7.1 SD01 SignIn



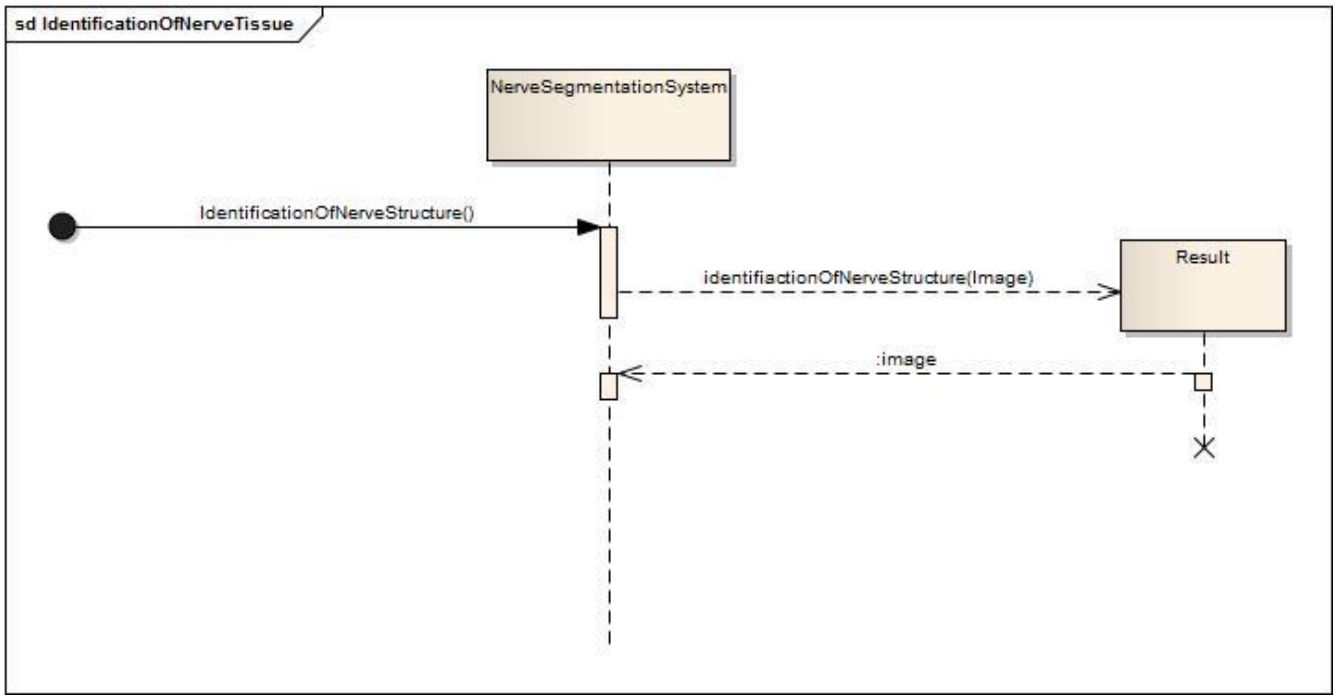
5.7.2 SD02 SignUp



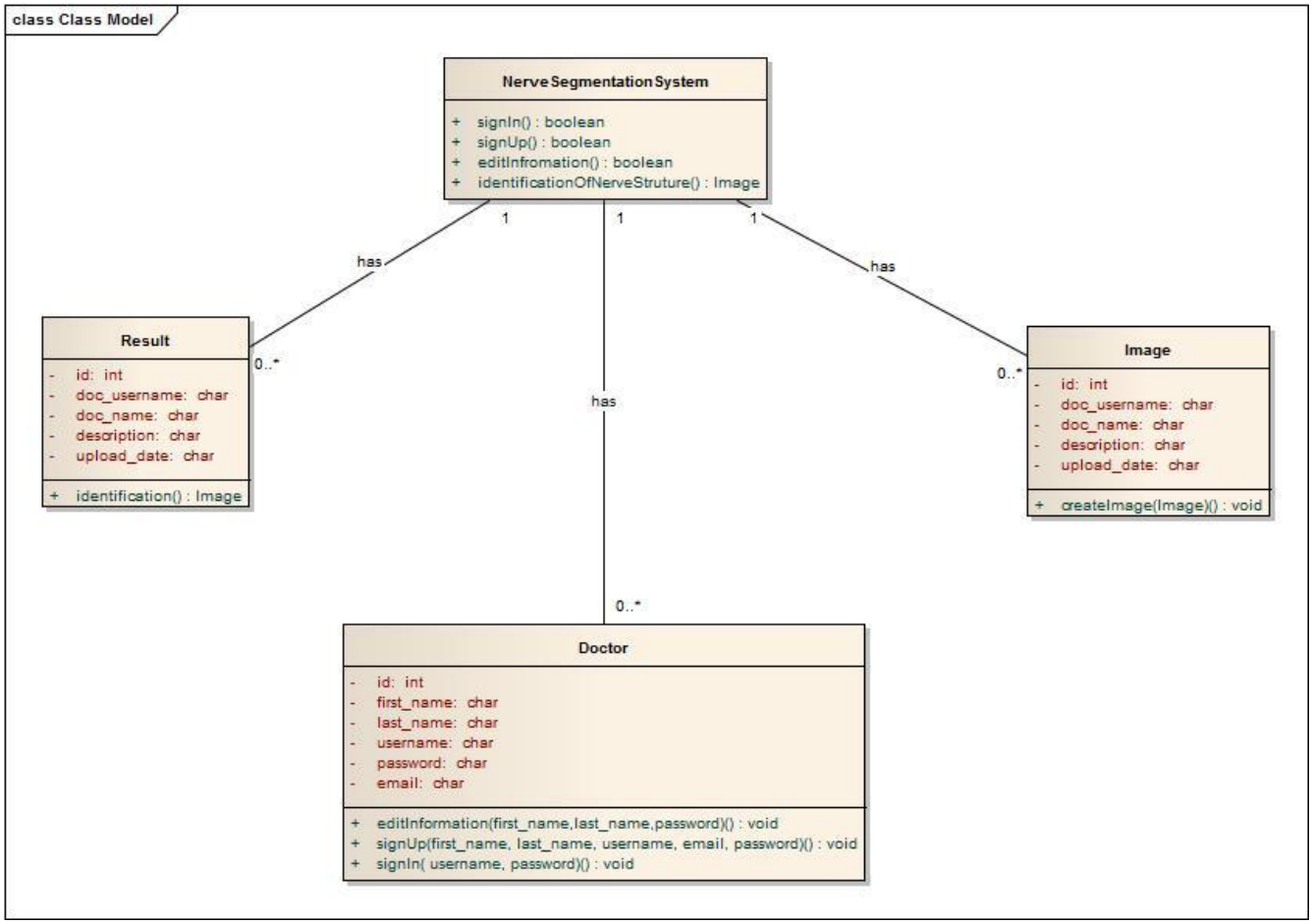
5.7.3 SD03 EditPersonalInformation



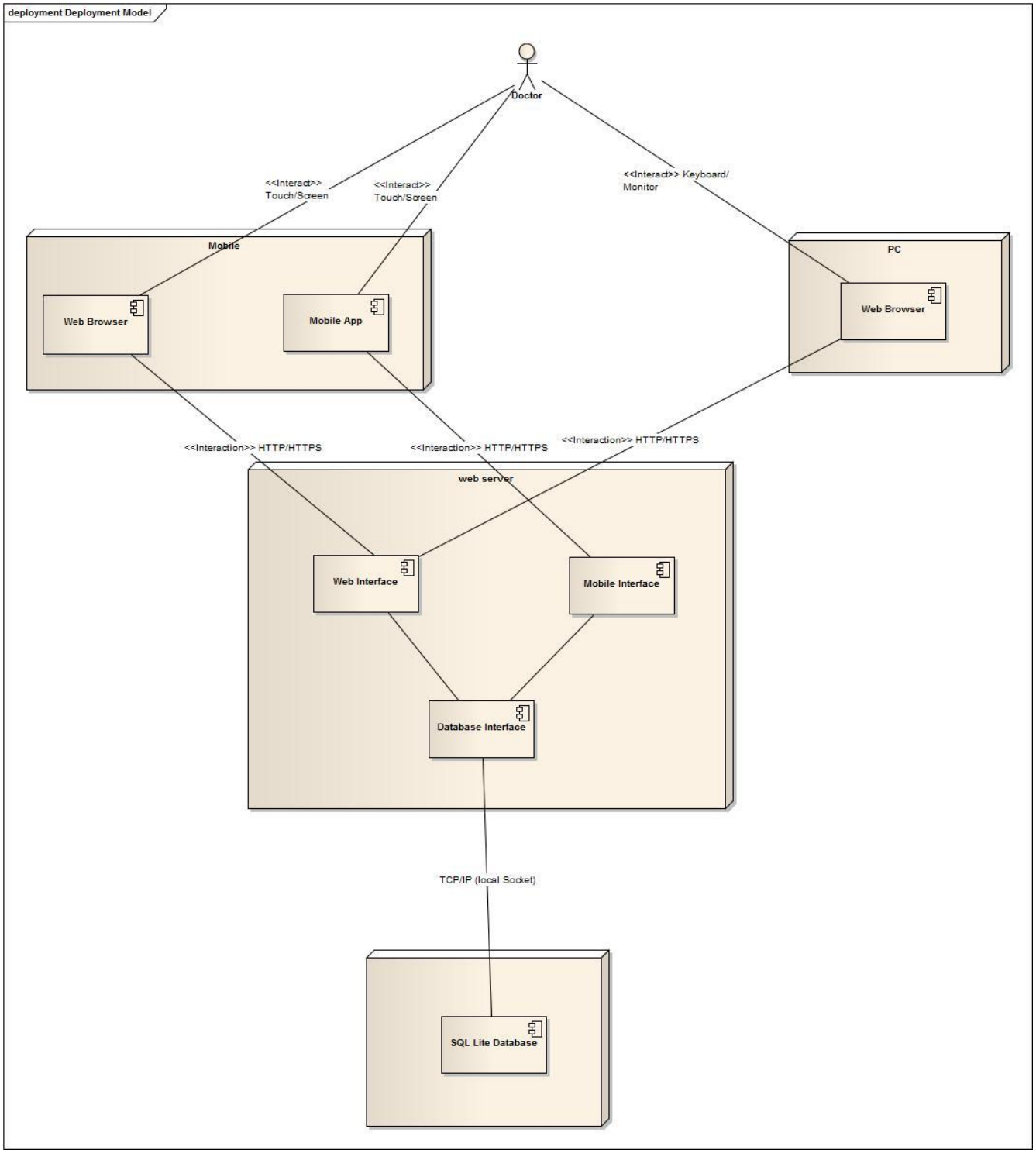
5.7.4 SD04 IdentificationOfNerveTissue



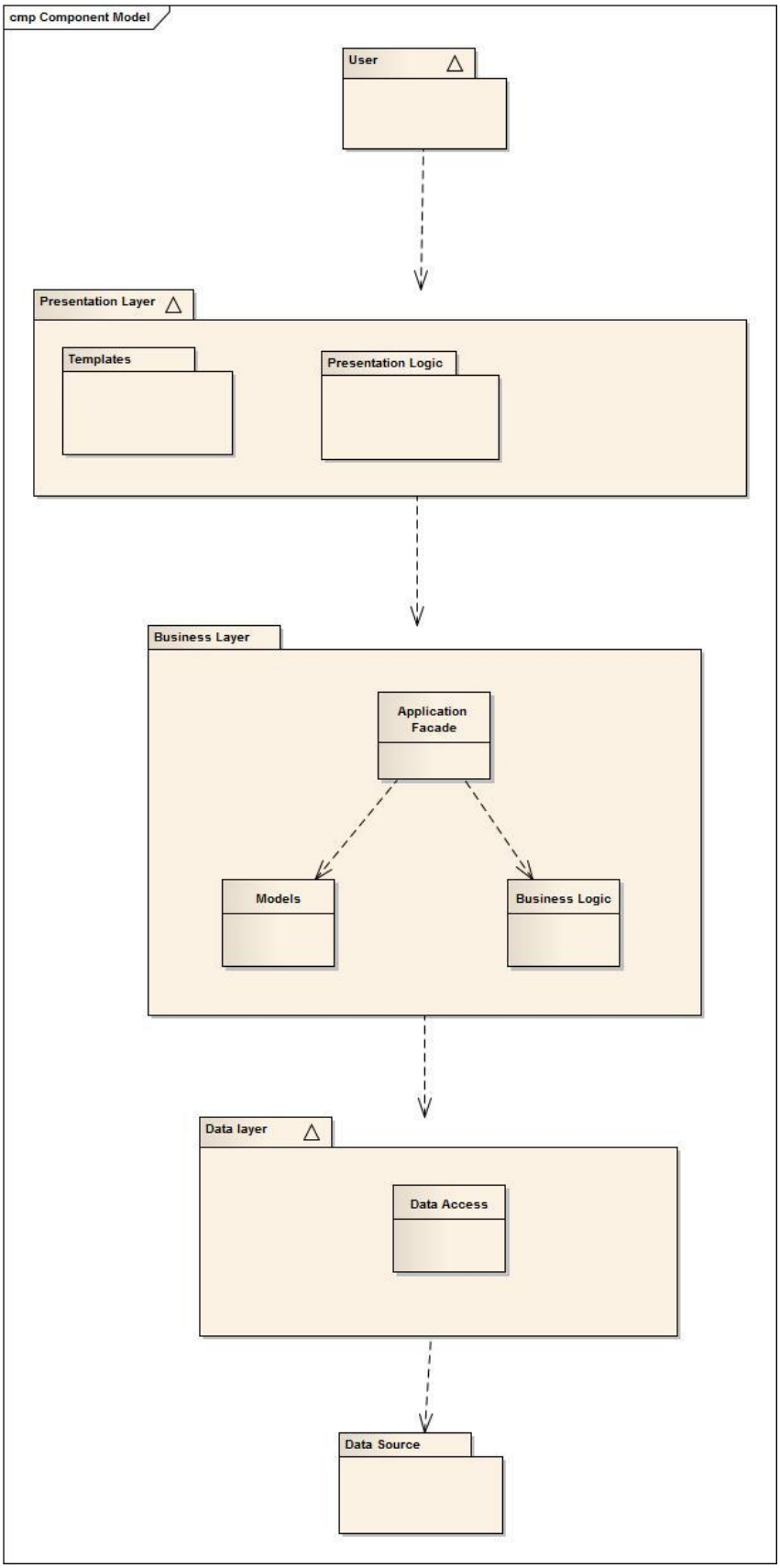
5.8 Class Diagram



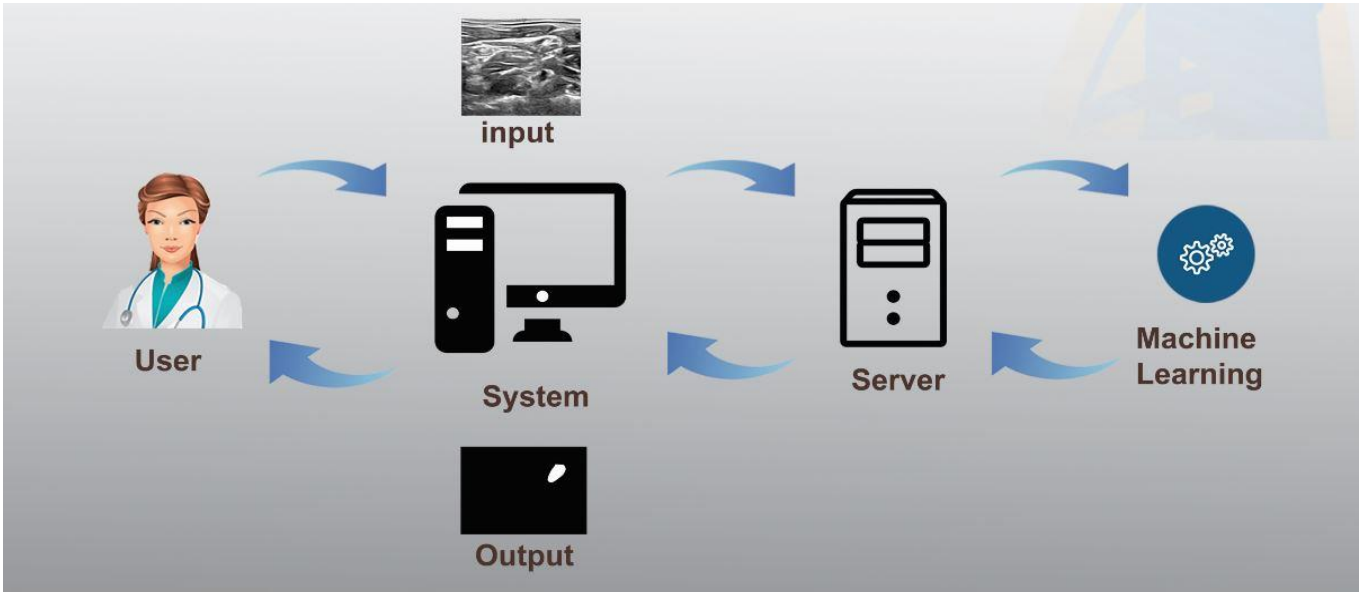
6. Deployment Diagram



7. Package Diagram



8. Architecture Diagram



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