Spring 2020 Analysis and Design Project Report

TEAM 9 (Benjamin Garcia, William Tsai, Mark Anthony Silva)
Github Repository: https://github.com/benjamingarcia10/S20-CS151-2-Team9
@benjamingarcia10 - Benjamin Garcia
@wtsai89 - William Tsai
@MarkAnthonySilva - Mark Anthony Silva

Table of Contents

Problem Statement

Tinnitus as a Medical Problem

According to the JAMA Clinical Practice guideline, tinnitus is the perception of sound without an acoustic stimulus (Walker 2016). In other words, the patient is hearing sounds that don't actually exist. The exact symptoms, types of sounds heard, and physiological characteristics of patients diagnosed with tinnitus varies from person to person, so the disease is not completely understood. However, medical experts in the field hypothesize that tinnitus is mainly caused from hearing loss, and the irregular neural activity in the brain that subsequently follows. Tinnitus affects an estimated fifty million adults in the United States (Walker 2016). The chance of getting tinnitus increases steadily with age and peaks in the 60's age group. The intensity of the symptoms and their effect on the quality of life varies from patient to patient. Some people are only mildly bothered by their tinnitus, while others are completely crippled by it. Only twenty percent of patients with persistent tinnitus ever seek medical evaluation (Walker 2016). Treating tinnitus is very difficult because there is currently no medical cure for it right now. As a result, patients often become discouraged when faced with this reality, despite hearing otherwise. The treatment of tinnitus is handled on a case-by-case basis and requires investigating potential causes, advising the patient to avoid treatments that are either not helpful or even harmful, and giving them the proper rehabilitation procedures essential in relieving symptoms and improving quality of life.

Source: Walker, D., Cifu, A., & Gluth, M. (2016). Tinnitus. JAMA, 315(20), 2221-2222.

Tinnitus Retraining Therapy Description

Tinnitus retraining therapy (TRT) is a treatment procedure that has been widely regarded as an effective therapeutic method for providing relief from tinnitus. It is a combination of directive counseling and sound therapy to help patients become more comfortably accustomed to living with their tinnitus. Directive counseling is a form of cognitive behavioral therapy designed to help patients emotionally regulate their reaction to tinnitus-related symptoms and to develop personal coping techniques. Sound theory is the strategic implementation of sound to help dampen the irregular neural activity in the patient's brain that is caused by tinnitus. One of the main features of TRT is the individualized counseling session, which involves asking the patient a series of questions in order to precisely evaluate the nature of and the severity of their tinnitus-related symptoms. The Tinnitus Handicap Inventory (THI) and Tinnitus Functional Index (TFI) questionnaires are used as standard ways to assess the impact of tinnitus and measure the treatment progress at subsequent visits. Based on the information the patient provided, they are also assigned a category ([0-4]) that indicates the type of tinnitus the patient is suffering from.

The individualized counseling session approach requires a substantial time commitment and specially trained therapists.

Source: Jastreboff, P., Møller, A., Langguth, B., Ridder, D., & Kleinjung, T. (2011). Tinnitus Retraining Therapy. In *Textbook of Tinnitus* (pp. 575-596). New York, NY: Springer New York.

Clinical Information System

The Clinical Information System (CIS) is an application designed to help support transactions in clinics that specialize in Tinnitus Retraining Therapy. The main goal of the CIS is registering treatment progress using the Tinnitus Handicap Inventory (THI) and Tinnitus Functional Index (TFI) questionnaires. The CIS supports the following transactions:

- Secure Login: Only qualified individuals that are given a username and password can log in to the CIS.

- Registering a new patient: Upon logging into the CIS, the clinic's Medical Professional has the option to register a new patient. On the 'new patient' screen there are fields to enter the following information: the patient's first and last name, date of birth, gender, phone number, address (fields for street address, city, state, zip, country), identification number in the clinic (ordering number), the date the patient was added to the system, their social security number, and their insurance number. There are also options to save the patient's data, to cancel the add transaction, and to add a new visit to the current patient. The patients added to the system can be viewed in a table format and edited.

- Managing visits: The clinic's Medical Professional also has the ability to add a new visit for any patient registered in the system. On the 'new visit' page there are fields to enter the date of the visit as well as the sequence number of the visit. The visits added to the system can be viewed in a table format, and can either display the visits of all patients or all of the visits of a single patient. There are also options to edit the existing visits. Completed visits also store THI/TFI responses and scores.

- THI/TFI questionnaires and scoring: After filling out the basic information on the visits screen, control is shifted over to the patient and they are directed to fill out the THI/TFI questionnaires. The patient is required to fill out all 25 questions for each questionnaire before being allowed to proceed. After everything is filled out, the scores are then calculated. The THI maps its score to a handicap category that describes the severity of the patient's symptoms (slight handicap to catastrophic handicap). The TFI calculates all 8 of its subscale scores (each subscale measures a particular domain of negative tinnitus impact such as sleep or sense of control) as well as the overall score.

Use Case Analysis

LOG IN

1. Medical Professional inputs their username and password
2. System check if the given username and password matches with a username and a password within the system
3. System opens the main menu

Variation #1: Wrong Username or Password

1. Medical Professional inputs their username and password
2. System check if the given username and password matches with a username and a password within the system
    a. System prints out " The given username or password is incorrect"

ACCESS PATIENT LIST

1. Medical Professional carries out the LOG IN use case
2. Medical Professional clicks the Patient list button
3. System opens up the Patient List Frame

REGISTER NEW PATIENT

1. Medical Professional carries out the ACCESS PATIENT LIST
2. Medical Professional clicks the Add Patient button
3. System opens up the Add Patient Frame
4. Medical Professional ask the patient for their basic information
    a. I.D. number
    b. Date the patient registers
    c. First and Last Name
    d. DOB
    e. Gender
    f. Phone number
    g. Address
        i. Street Address 1
        ii. Street Address 2
        iii. City
        iv. State
        v. Zip
        vi. Country
    h. Social Security Number
    i. Insurance number

   j. Optional information
      i. Occupation
      ii. Work Status
      iii. Educational Degree
5. Medical Professional inputs that information into the system
6. Medical Professional clicks the done button
7. System saves the information
8. System returns to the patient list with the new patient added

Variation #2: Medical Professional wants to cancel Register operation

1. Medical Professional carries out the ACCESS PATIENT LIST
2. Medical Professional clicks the Add Patient button
3. System opens up the Add Patient Frame
   a. Patient for any reason no longer wants to be added or Medical Professional wants to no longer add the patient
   b. Medical Professional simply clicks the Main Menu button at the bottom of the Frame
   c. System immediately closes the Add Patient Frame and opens the Main Menu Frame

ACCESS PATIENT INFORMATION

1. Medical Professional carries out the ACCESS PATIENT LIST
2. Medical Professional navigates and clicks the name of the Patient they want to edit
3. A Patient Frame is opened that shows all the information of the patient
   a. Basic information
   b. Optional information
   c. Etiology and Onset of both tinnitus and hyperacusis
   d. Discretionary Notes added by Medical Personnel
   e. Visits

EDIT PATIENT INFORMATION

1. Medical Professional carries out the ACCESS PATIENT INFORMATION
2. Medical Professional clicks the Edit button
3. Medical Professional is now able to change the necessary information wanted which includes
   a. Basic information
   b. Optional information
   c. Etiology and Onset of both tinnitus and hyperacusis
   d. Discretionary Notes added by Medical Personnel
   e. Visits

VIEW VISIT OPTION 1

1. Medical Professional carries out the LOG IN use case
2. Medical Professional clicks the View Visits Button
3. System opens the visit frame which displays a list of all visits by all patients sorted by date

VIEW VISIT OPTION 2

1. Medical Professional carries out the ACCESS PATIENT INFORMATION use case
2. Medical Professional clicks the Visits button
3. System opens the visit frame which displays a list of all patient's visits

ADD/REGISTER A NEW VISIT

1. Medical Professional carries out VIEW VISIT OPTION 2 use case
2. Medical Professional clicks the Add visit button
3. System opens a new frame that displays where the date of visit, visit sequence number, and additional notes can be inputted
4. Medical Professional inputs the information
5. Medical Professional clicks Done
6. System returns to the patient's visit frame

Variation #2: Initial Visit (Initial Interview required)

1. Medical Professional carries out VIEW VISIT OPTION 2 use case
2. Medical Professional clicks the Add visit button
3. System opens a new frame that displays where the date of visit, visit sequence number, and additional notes can be inputted
4. Medical Professional inputs "0" as the visit sequence number indicating that this is the initial visit meaning an initial interview is required
5. After all information is entered, Medical Professional clicks done and screen goes to Tinnitus/Hyperacusis initial Interview Form with client information auto populated at the top of the screen.
6. Medical Professional collects all information and inputs in the form fields
7. Medical Professional clicks Done
8. Screen shows category fitting the patient
    a. 0 - tinnitus present but no impact on life
    b. 1- tinnitus present and has high impact on life
    c. 2 - hearing problem present and relevant
    d. 3 - hyperacusis (decreased sound tolerance) is a major problem
    e. 4 - prolonged tinnitus exacerbation)

9. Screen also shows 5 treatment protocols (0-4) to select from after Medical Professional consults with the patient
10. Medical Professional selects a treatment protocol and clicks Done
11. System returns to the patient's visit frame

EDIT A VISIT

1. Medical Professional carries out VIEW VISIT OPTION 1 or VIEW VISIT OPTION 2 use case
2. Medical Professional selects the desired visit to be edited
3. Visit frame pops up with expanded information for visit
4. Medical Professional clicks edit button on visit frame
5. The Medical Professional can then either edit the information in the visit or delete the visit
    a. Information to be edited
        i. Date of visit
        ii. Visit sequence number
        iii. Additional notes
6. Medical Professional clicks Done
7. System returns to the visit frame

SCHEDULE AN APPOINTMENT

1. Medical Professional carries out VIEW VISIT
2. Medical Professional click schedule button
3. System opens the schedule panel
4. Medical Professional can input the name of the patient and date of appointment
5. Medical Professional clicks done

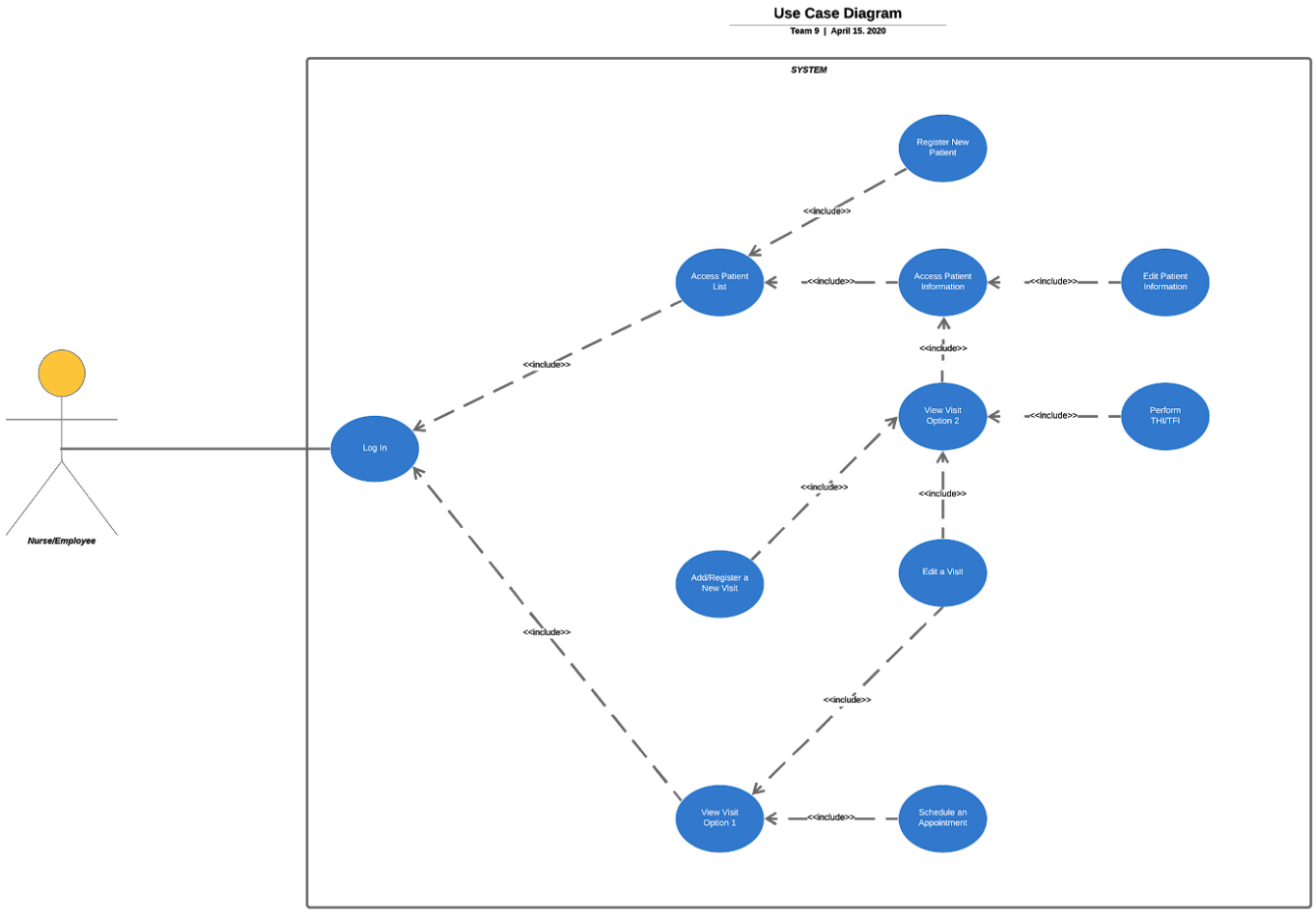
<u>Topic 2: Registering Treatment Progress Use Cases</u>

PERFORM THI/TFI

1. Medical Professional carries out VIEW VISIT OPTION 2 use case
2. Medical Professional clicks the Add visit button
3. System opens a new frame that displays where the date of visit, visit sequence number, and additional notes can be inputted
4. Medical Professional inputs a nonzero number as the visit sequence number indicating that this is a subsequent visit meaning a progress evaluation is required
5. After all information is entered, Medical Professional clicks done and a new panel pops up displaying the Tinnitus Handicap Inventory questionnaire. (https://www.ata.org/sites/default/files/Tinnitus_Handicap_Inventory.pdf).

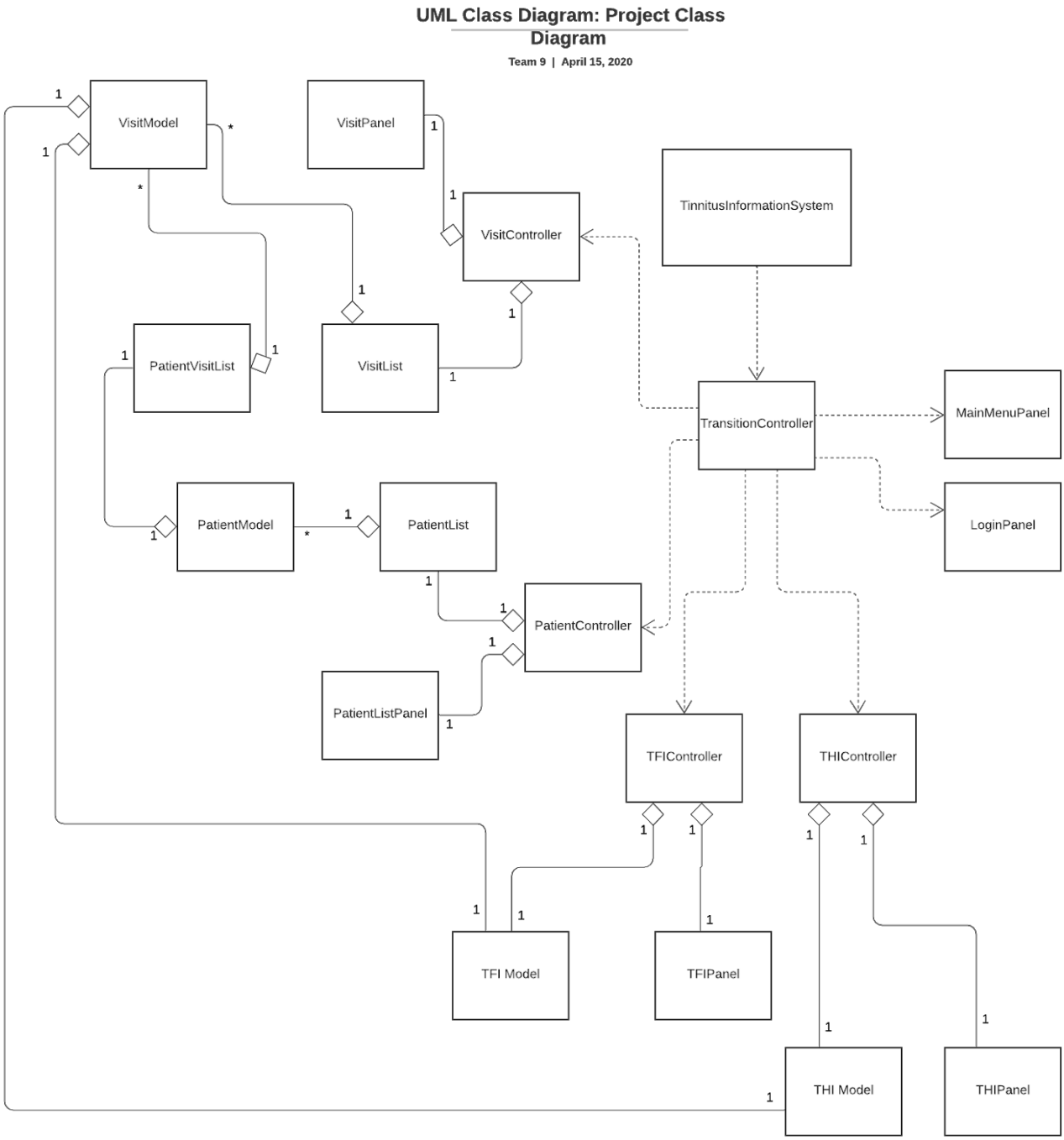
6. Patient fills out the questionnaire and clicks submit when done. The current panel closes and a new panel pops up displaying the Tinnitus Functional Index questionnaire. (http://download.lww.com/wolterskluwer_vitalstream_com/PermaLink/EANDH/A/EANDH_2011_09_27_HENRY_200593_SDC15.pdf)
7. Patient fills out the questionnaire and clicks submit when done. The panel closes and the users are returned to the main screen which now displays the results. The patient's resulting score is calculated by taking the average of both the THI and TFI scores. The patient receives a diagnosis of their condition based on the score, as well as a comparison to their previous score. For example, according to the Tinnitus Functional Index (https://www.audiology.org/news/tinnitus-functional-index) a meaningful change occurs when the scores are reduced by 13 or more.

UML Use Case Diagram

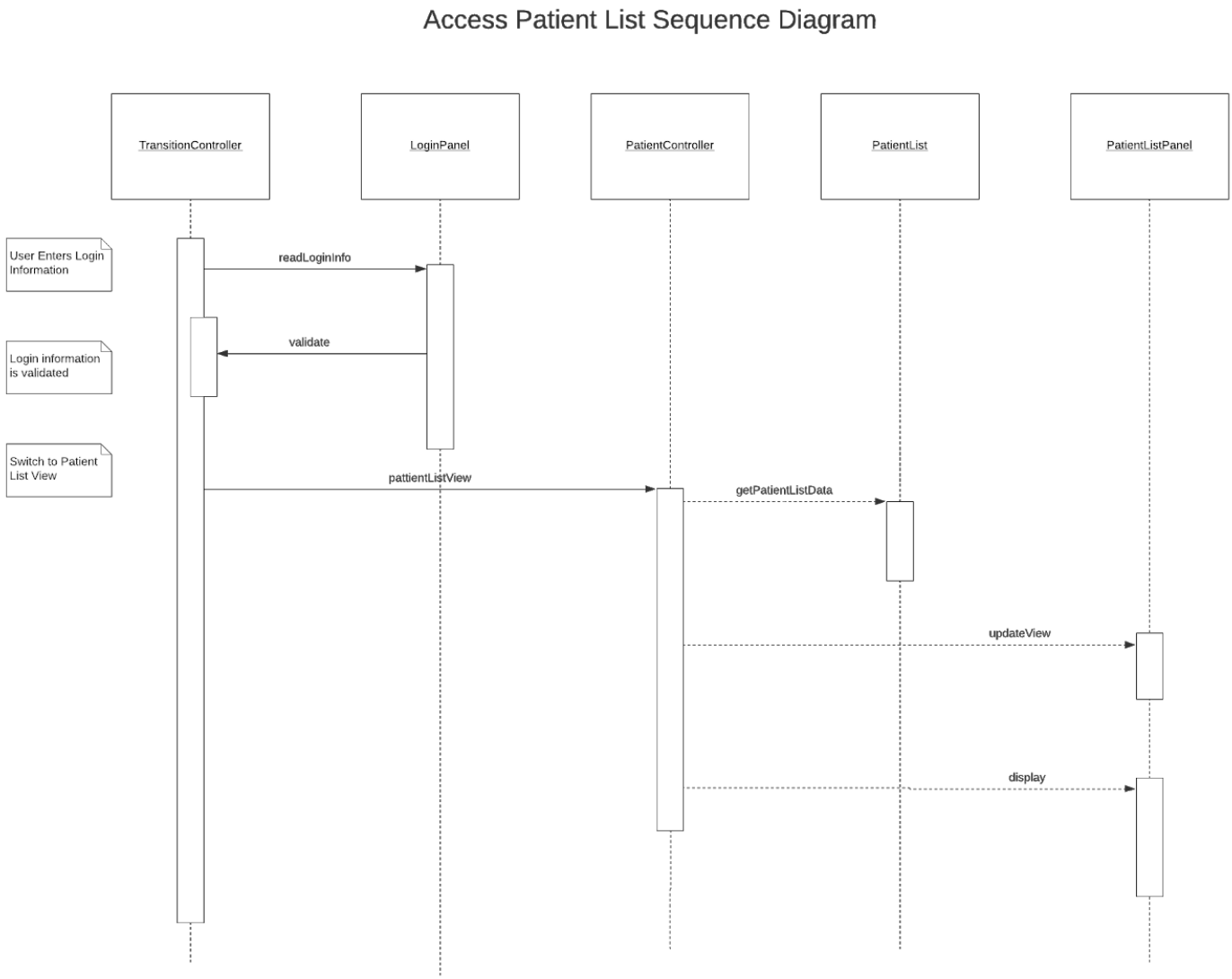


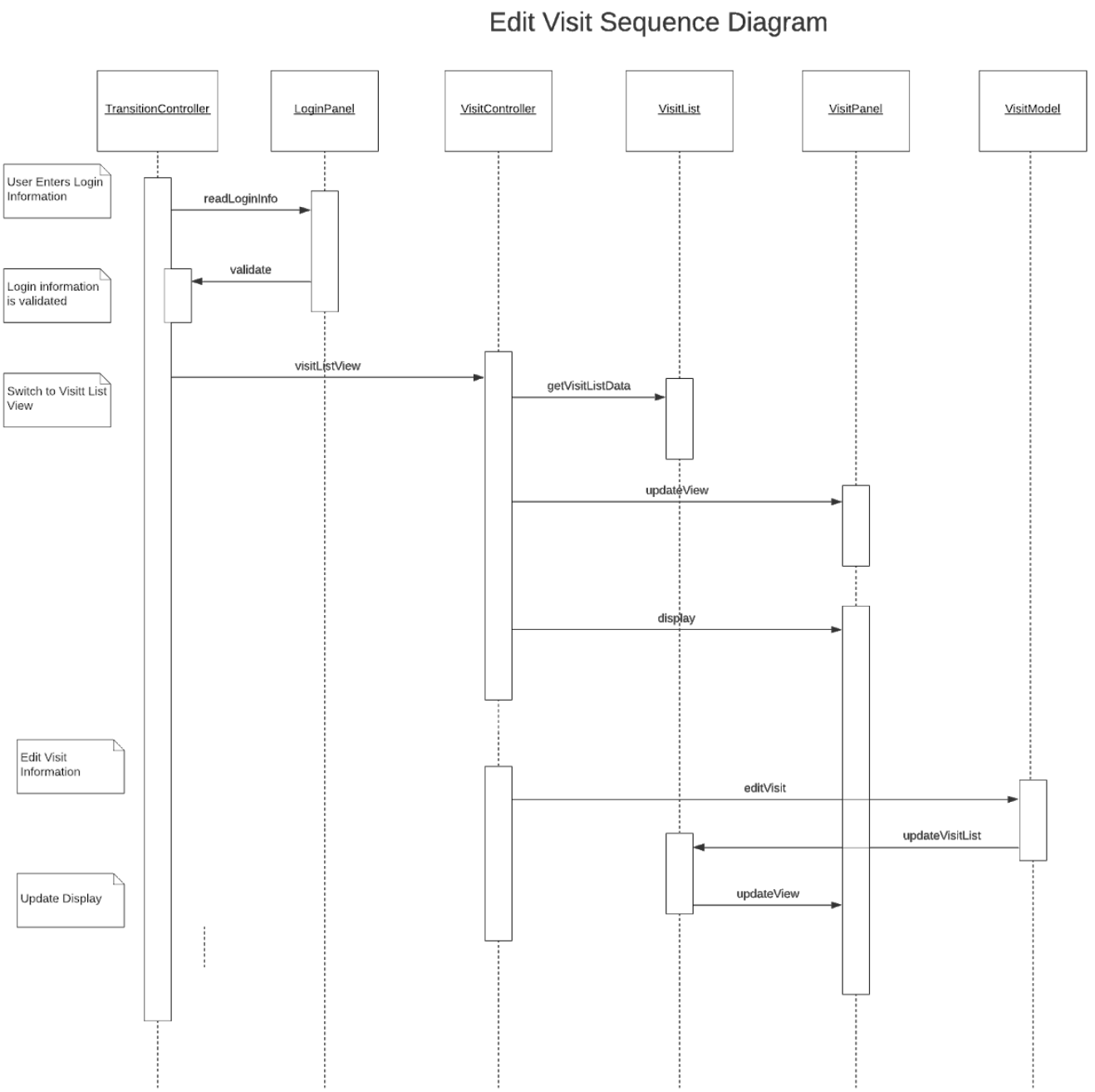
Link to higher resolution image:
https://www.lucidchart.com/invitations/accept/c71feee2-7ccc-471b-9d83-d9ab8eef2a1f

UML Class Diagram

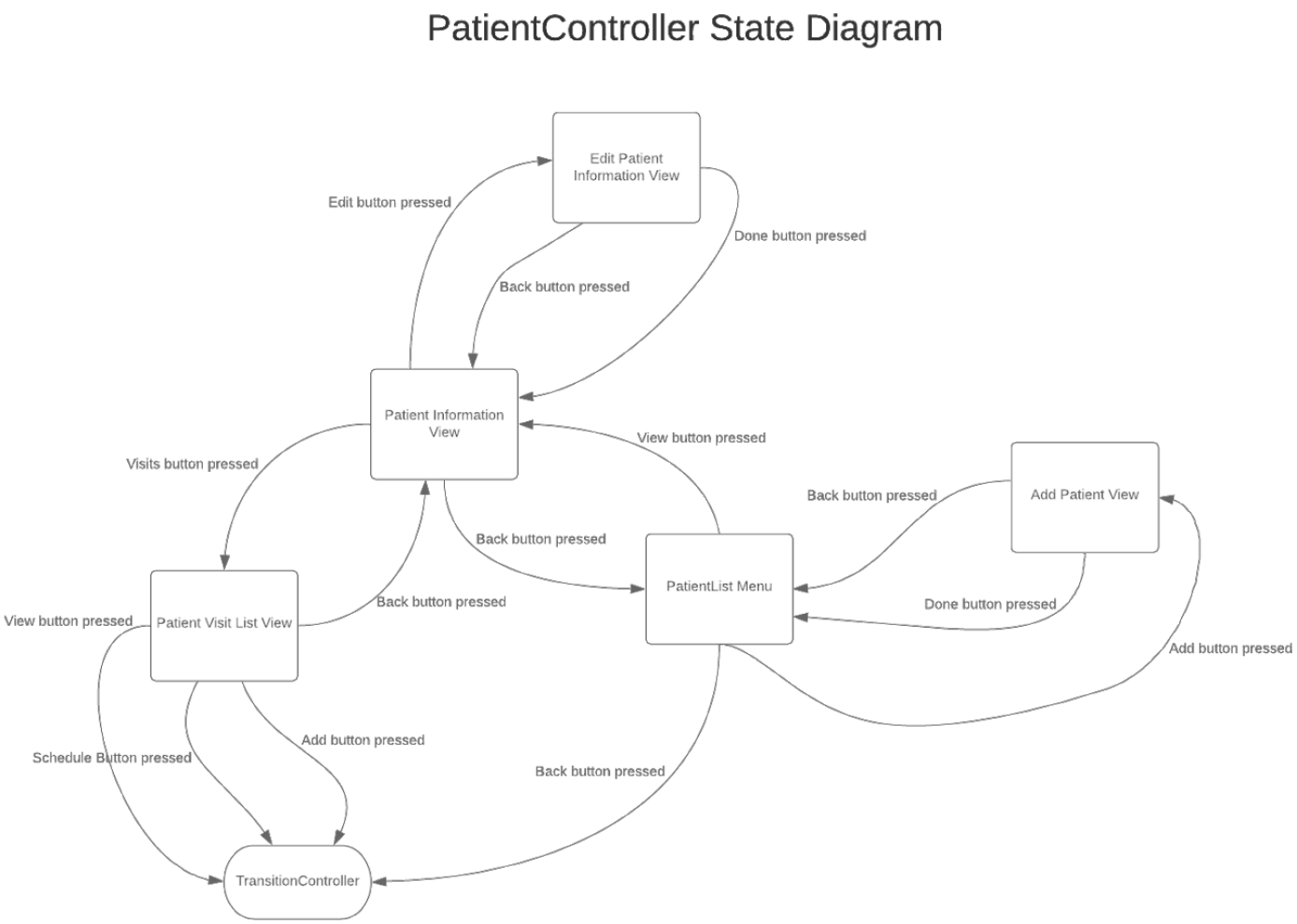


UML Sequence Diagrams




Edit Visit Sequence Diagram
TransitionController
LoginPanel
VisitController
VisitList
VisitPanel
VisitModel
User Enters Login Information
readLoginInfo
validate
Login information is validated
visitListView
Switch to Visitt List View
getVisitListData
updateView
display
Edit Visit Information
editVisit
updateVisitList
Update Display
updateView

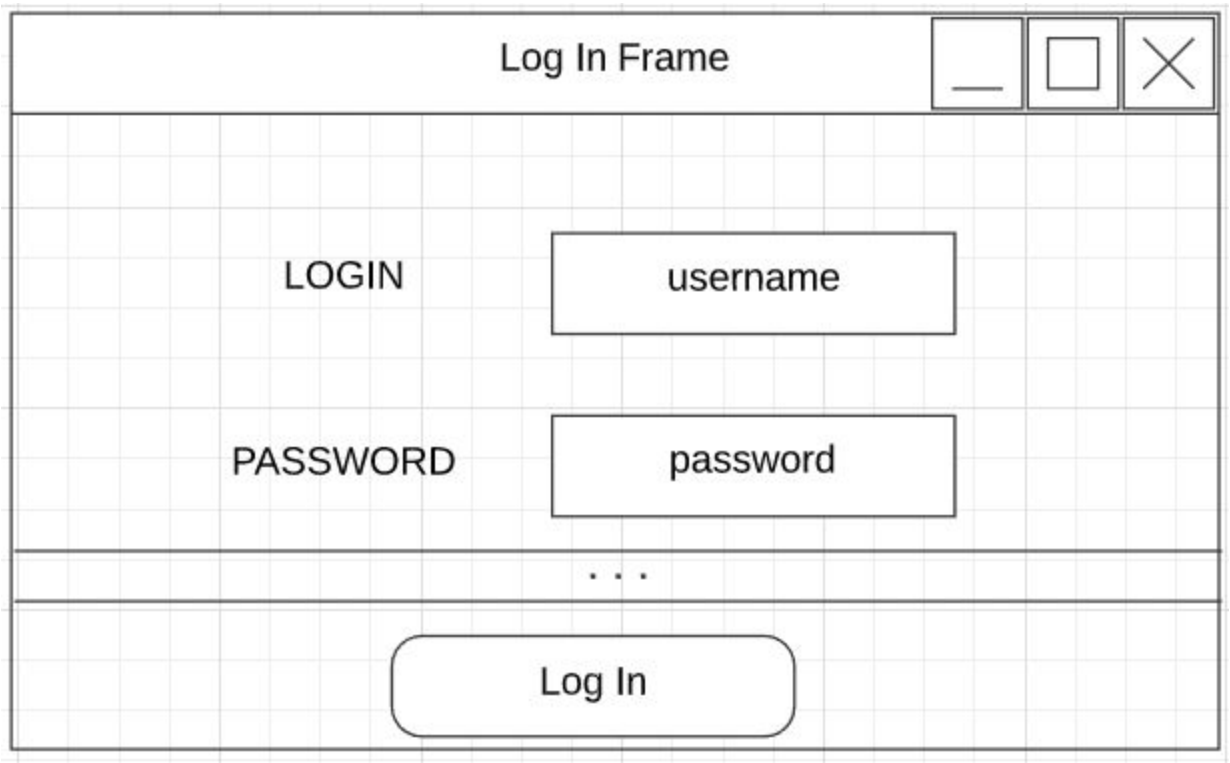
UML State Diagram



Mock User Interface

The majority of our mock user interface frames would implement a border layout where the south border will be used to contain all the action buttons like done, back, add, and edit. The purpose of these buttons are to be able to easily navigate the system and interact with the system.

LOG IN FRAME

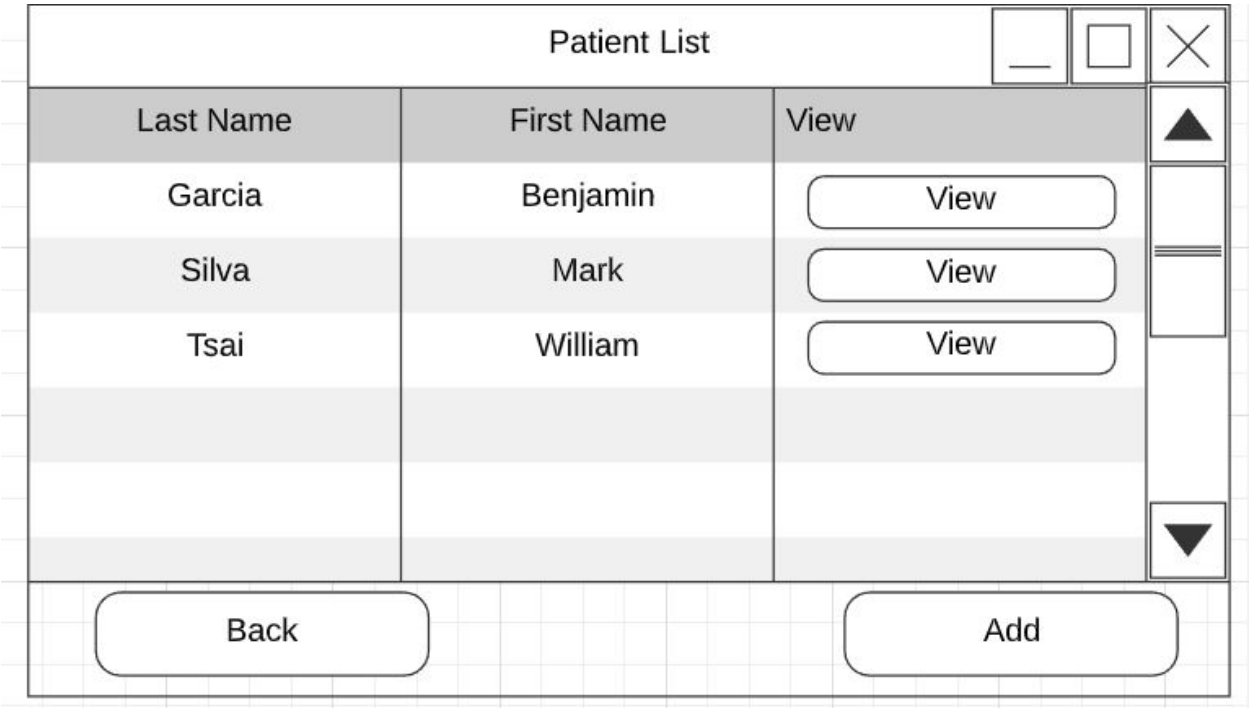


The Log In Frame will use a flow layout and a border layout where the center of the border layout would be used for the Log In and Password prompts. At the same time, a flow layout would be used in the center while the south border would just be dedicated to the Log In button that will lead to the Main Menu. The username and password text boxes represent the input fields for the username and password for a certain Medical Professional. This frame will be used as the base frame where all the other panels are placed on top off.

Main Menu

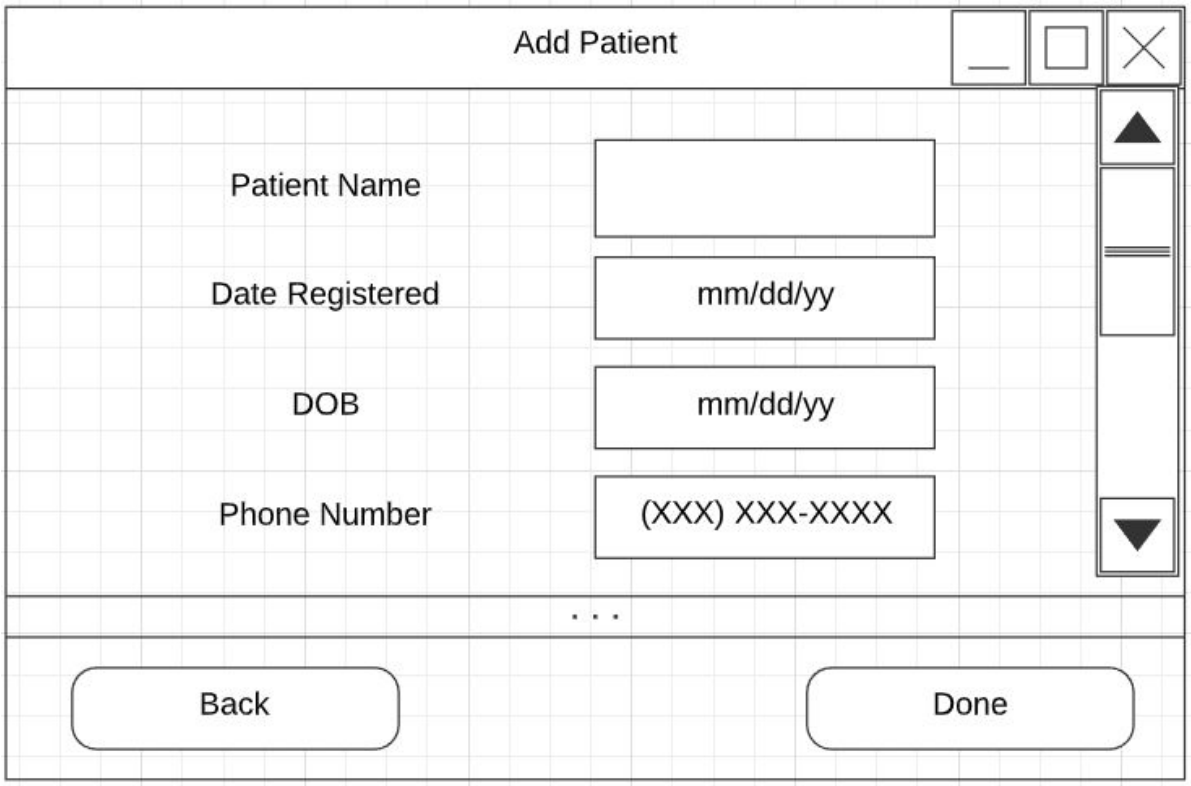
After pressing the Log In button at the Log In Frame, a new panel will replace the old one that is in a box layout in a vertical fashion. By clicking either the "View Patient List" or the "View Visit List", the system will pull up the relevant view classes to be displayed while pressing the log out button will return the user to the Log In Frame. This simple layout will help users immediately see what actions they are able to perform at the moment.

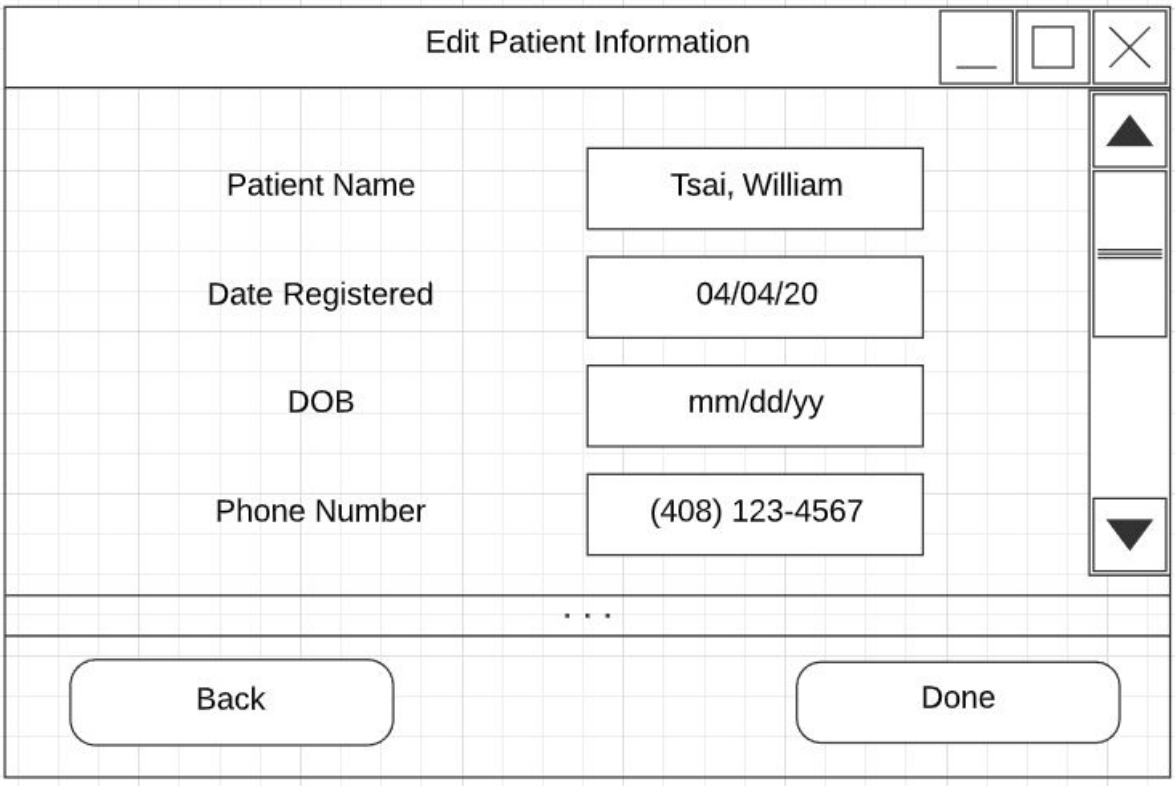
Patient List



If the user clicks the "View Patient List" button at the Main Menu, the system will make the Patient List visible. A scroll bar has been added to allow users to navigate the table if the number of patients increases to the point that they cannot be displayed all at once. The table would sort them by the alphabetical order of their names, and the table itself will only display the last name and first name of a patient. At the south border, there are two buttons available. Clicking the "Back" will bring back the user to the Main Menu while the "Add button" will open a new panel that will allow the user to add a new patient to the table. Meanwhile, clicking any of the "View" button allows the user to see the information of the patient at the row of that view button.

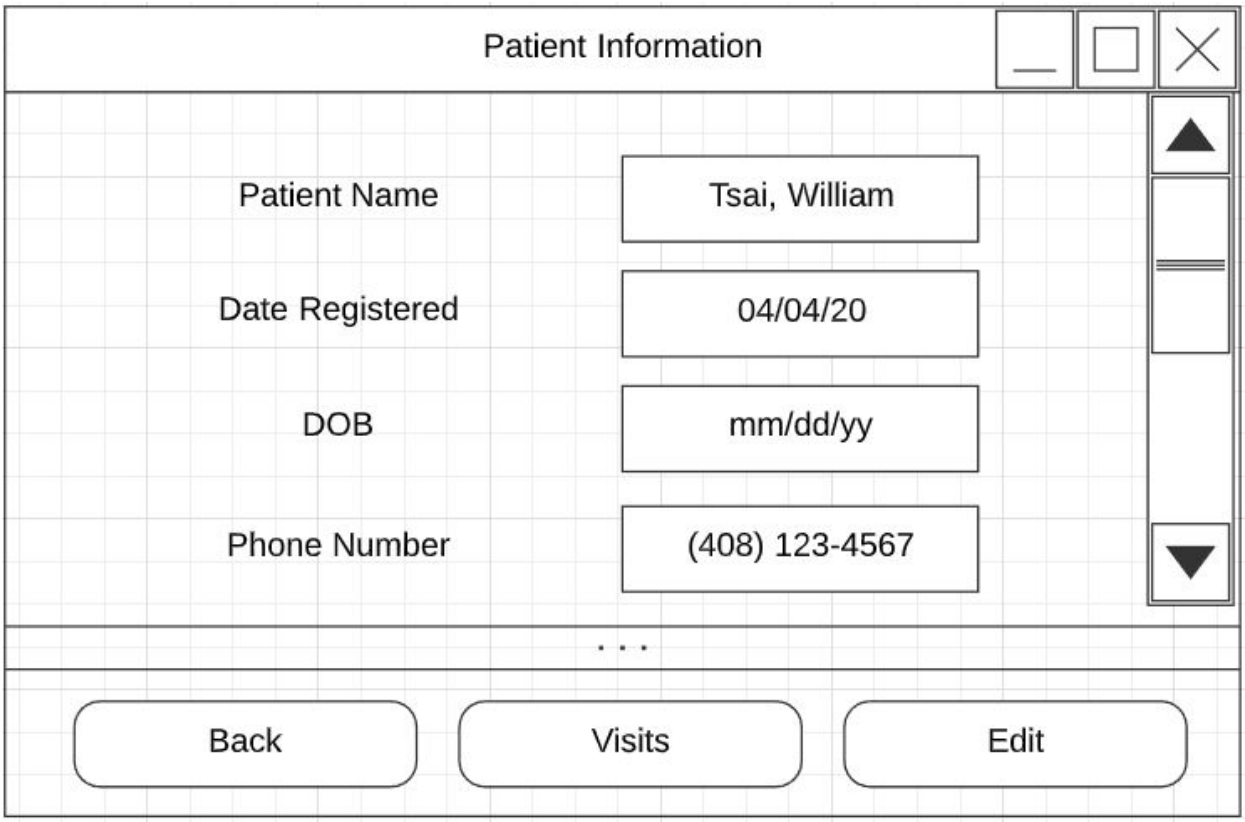
Add/Edit Patient





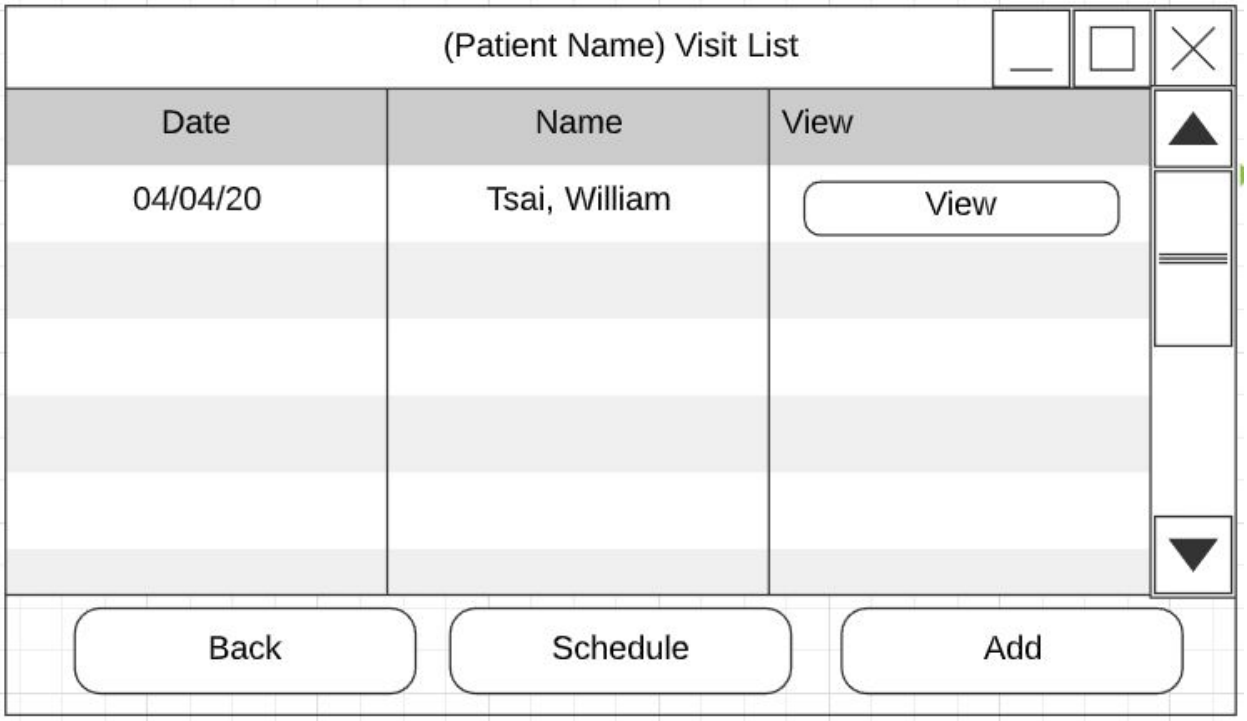
This panel will appear when the add button is selected on the Patient List. All the text boxes are able to be inputted with strings that will only be stored into the system when the Done button is pressed. Otherwise, pressing the back button would cancel the add patient and return to the patient list.

Patient Information



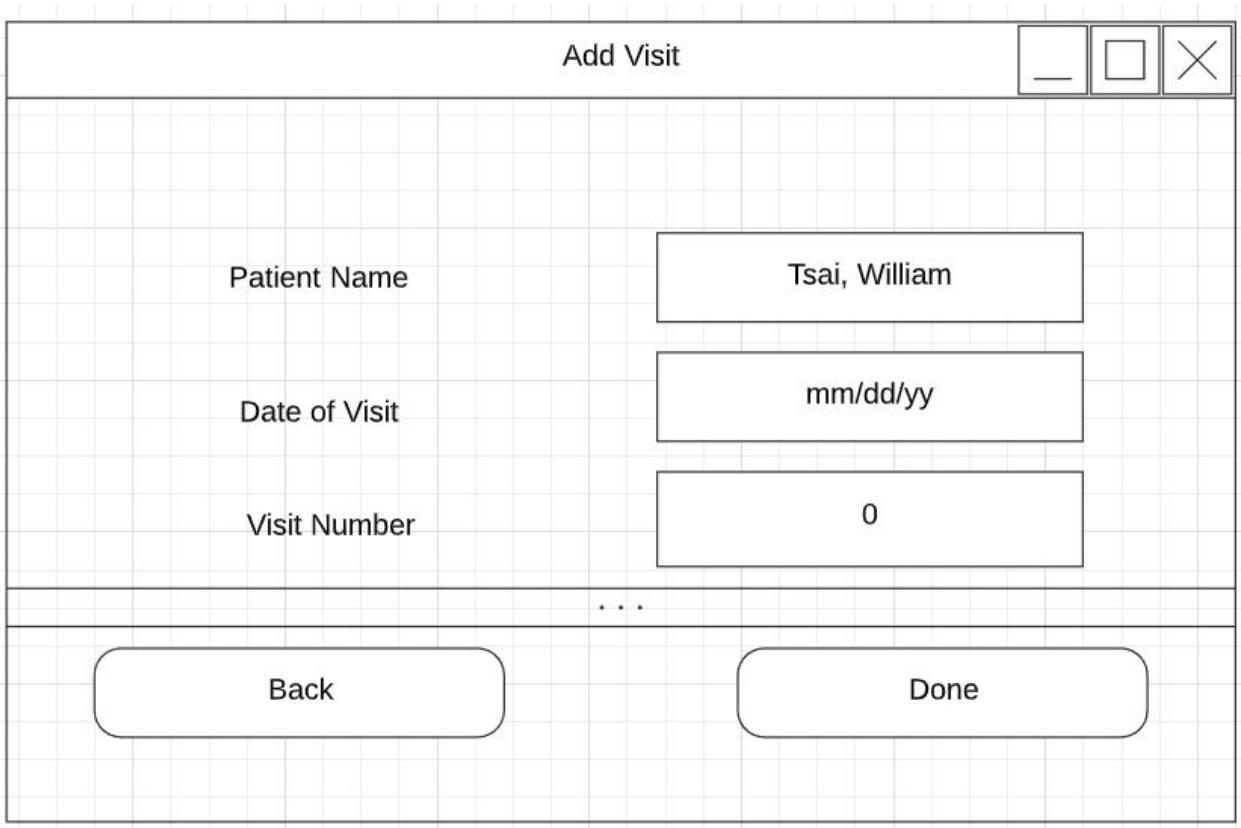
This is similar to the Add Patient panel except the information cannot be edited, and it can be opened by clicking the View button on the patient list panel. The only difference being the Visits button. When the Visits button is clicked, it will open another panel that displays all the Visits of this patient to the clinic. The following horizontal vertical layout was chosen since it clearly shows the information in an organised manner without looking cluttered.

Visit List and Patient_VisitList



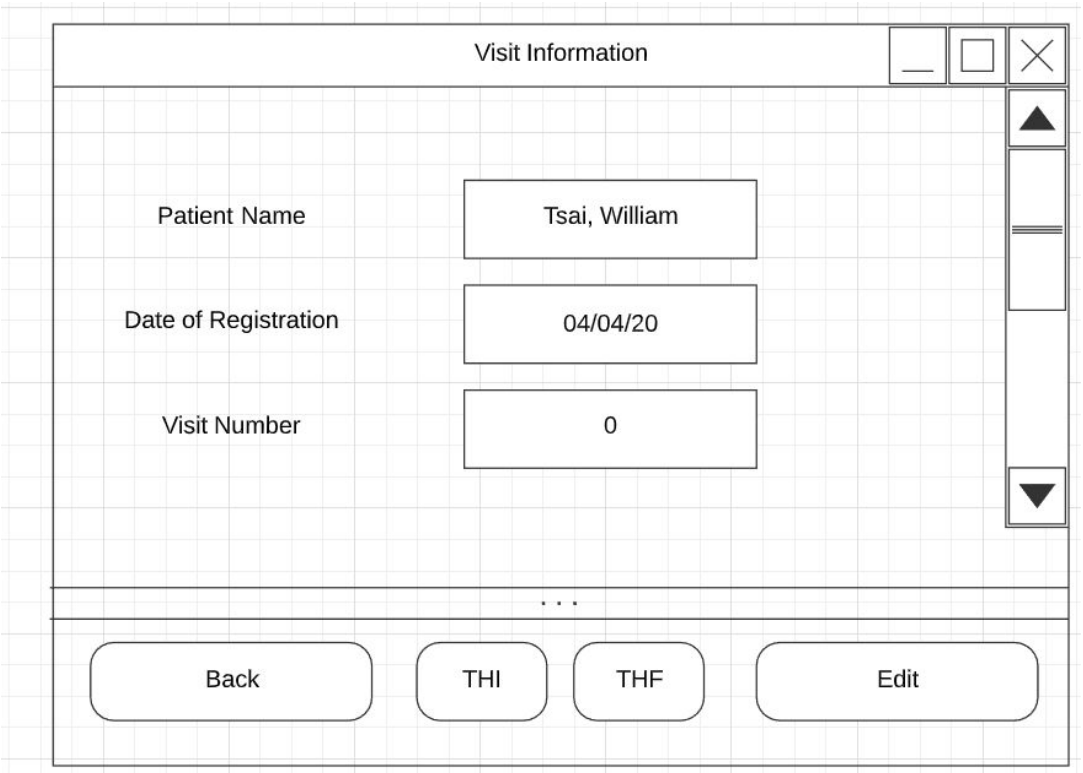
The Patient visit list table will open when clicking the Visits button on the Patient Information panel. The only visits displayed here are the ones that the patient took part in. There are also two extra functions on this panel. There is the View button that will display the information of the visit on the same row. There is also an add button that can add another visit onto the visit list. At the same time, the visit list table is similar to the Patient visit table except the user can view all the visits. The user cannot add or schedule future visits like in the Patient visit table. We decided on having two visit lists since it would allow for easier access of visits.

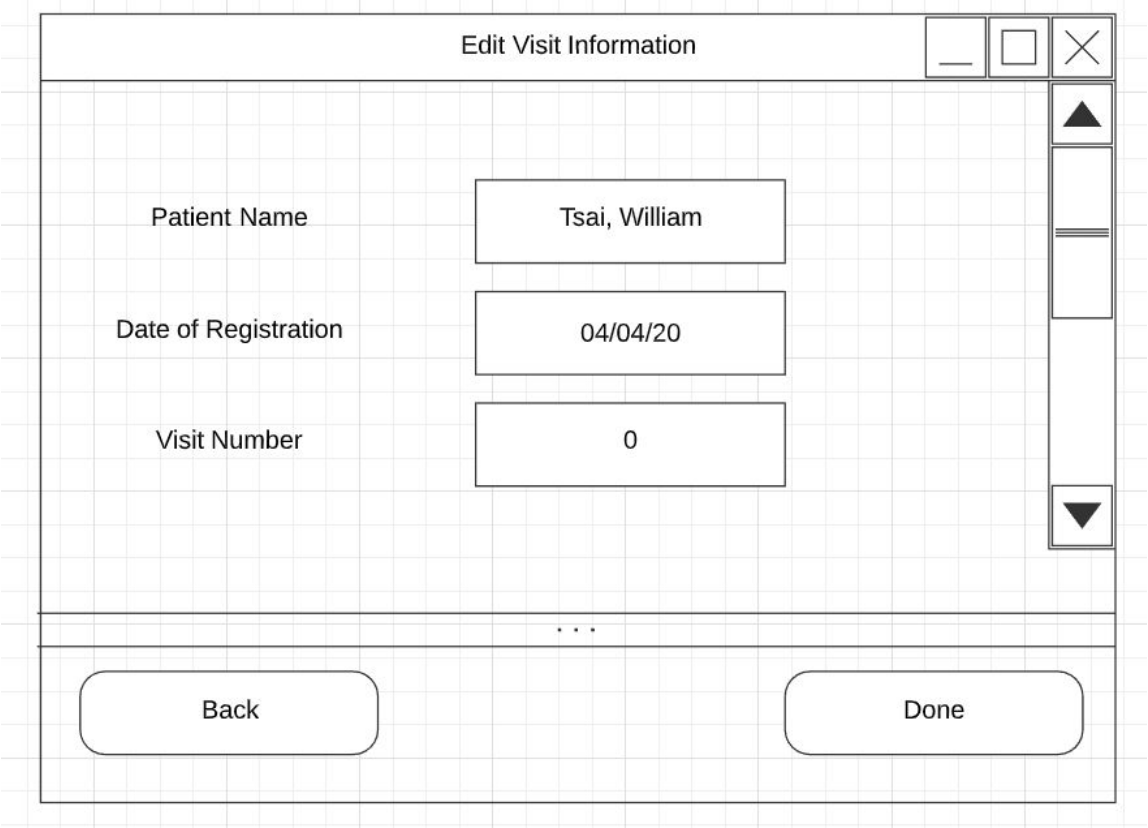
Add Visit



The following panel will open once the add button is clicked on the Patient visit list. In this panel, the user is able to input the name of the patient, the date of the visit, and the visit number for this patient.

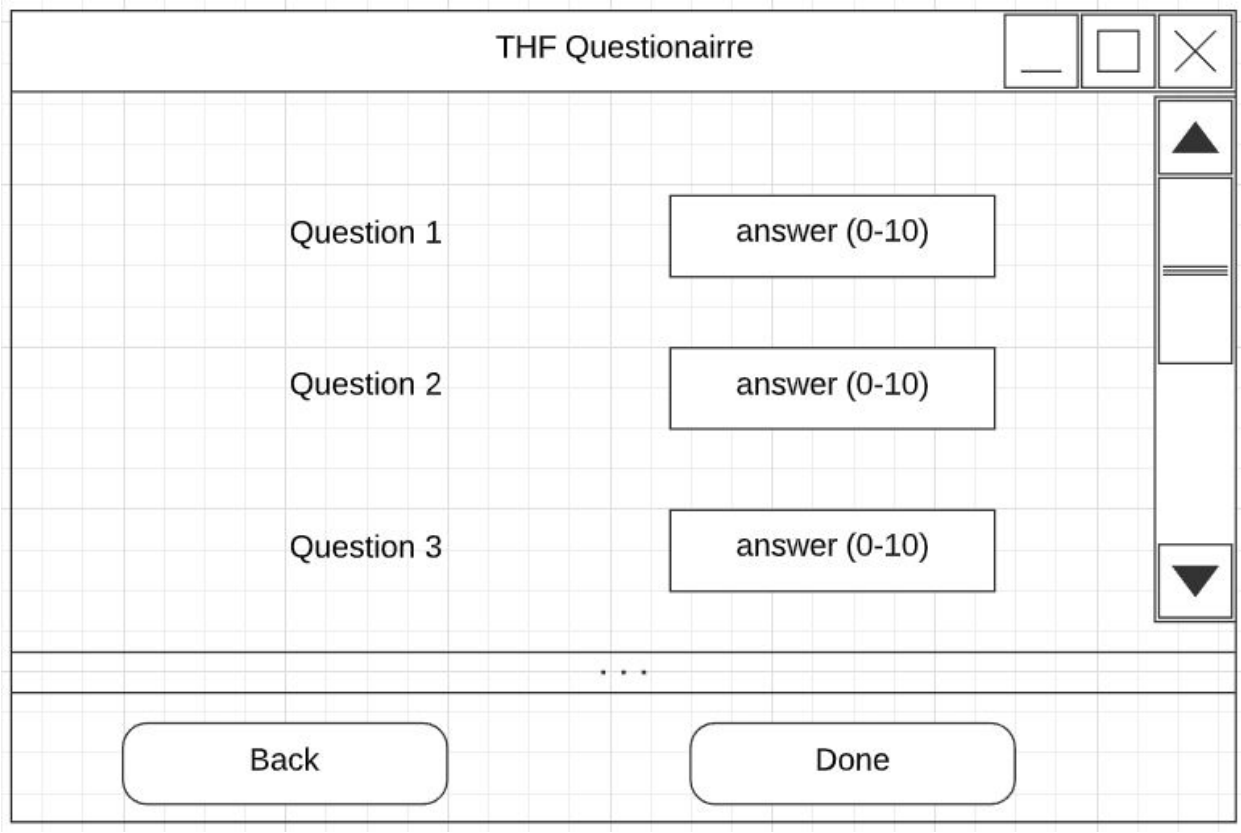
Visit Information and Edit Visit Information





The Visit Information panel opens when either the view button is clicked on the Patient visit list or the regular visit list. In this panel, it will display the information of the visit like the name of the patient who is registered with this patient, the date of the visit, the sequence number of the visit, and finally the THI and TFI score for this visit. Next, the Edit Information panel opens after the Edit button is clicked on at the Visit Information panel, and it allows for the information about the visit to be edited through clicking on the text boxes.

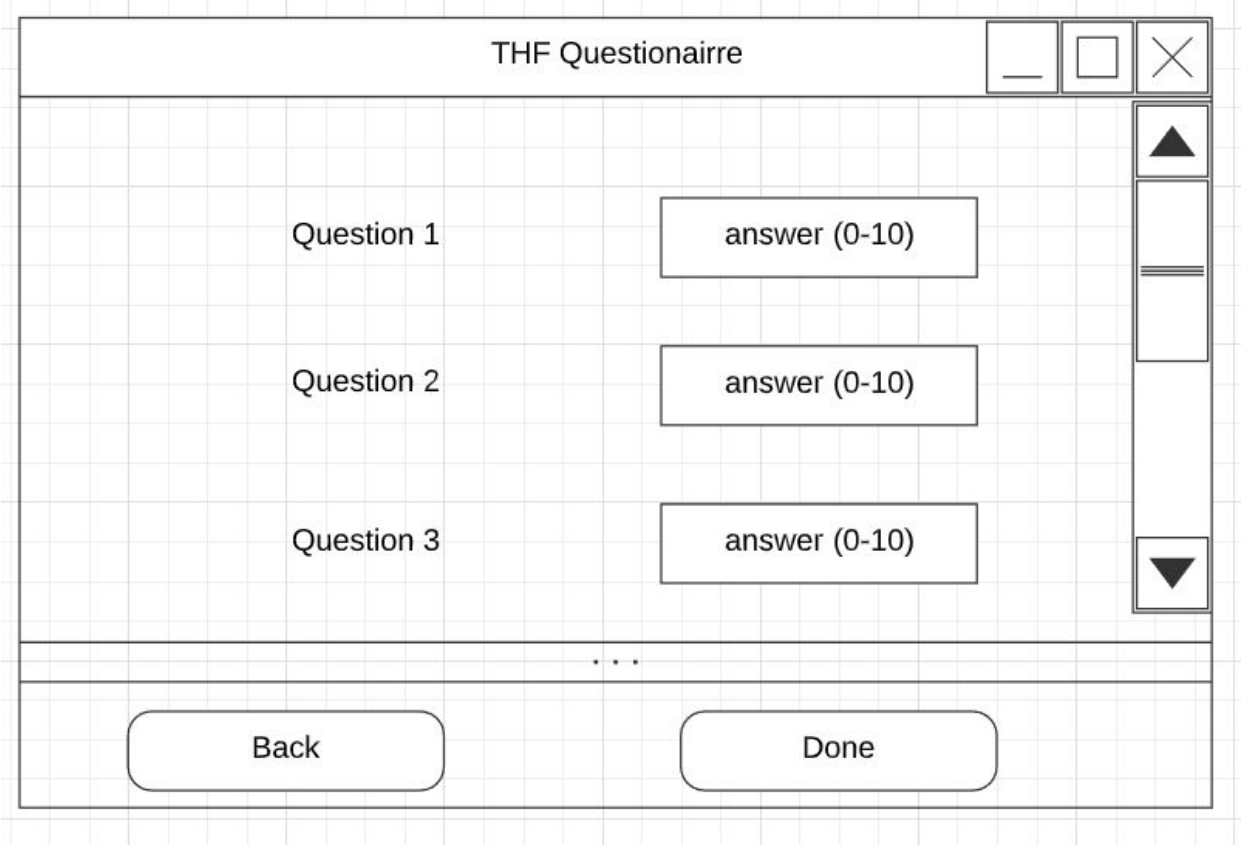
THI Questionnaire



The THI Questionnaire pattern is accessed through the Visit Information panel by clicking the THI questionnaire. All 25 questions of the THI will be displayed here with only the 0, 2, 4 answers being able since it is set up like that in the actual paper version of the THI. As a

result, it is less likely for a user to be confused on how they should input their answers because it has been limited to the 3 options.

THF Questionnaire



Finally, the THF Questionnaire is accessed through the visit information panel. It is similar to the THI layout in terms of the layout of the panel. The one key difference is that the answers can be inputted in a text box since there is a much larger range of answers in the THF compared to the THI. If the THF input was similar to the THI, it would result in a very cluttered looking panel since there would be 10 separate inputs that the user would see at once.

Implementation

For the application of MVC Pattern, a main frame was created where all the different panels of the system would be displayed from. Each panel had a controller that would listen to all the commands and inputs done in their respective panel. Only the controllers had access to the model classes like the patient list and visit list which separated the view and model from each other.

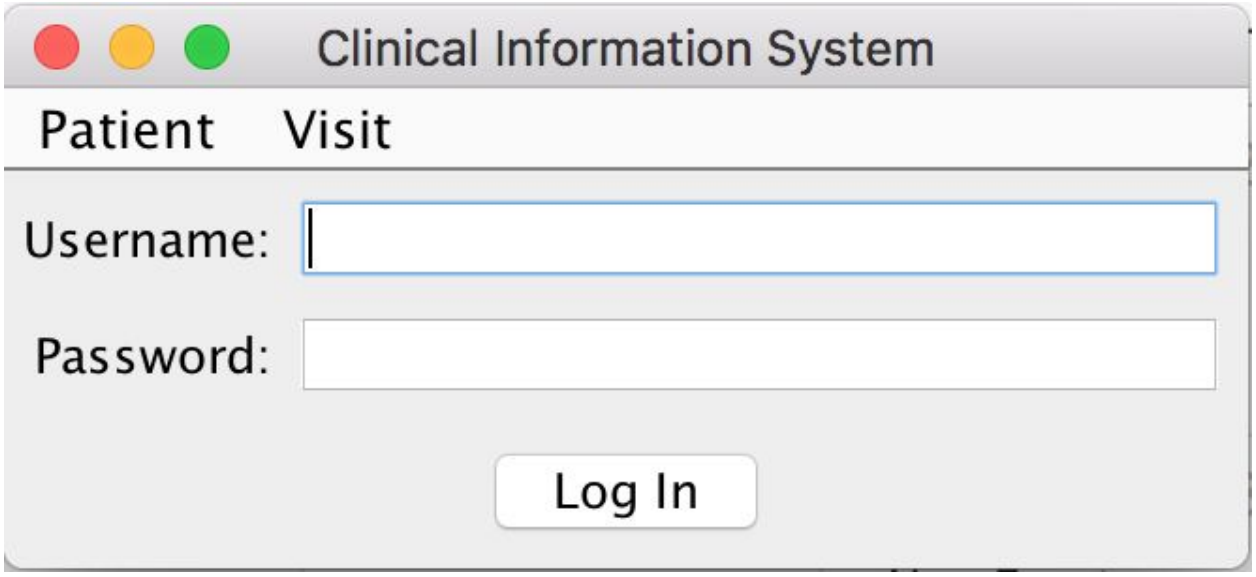
There is an extensive use of the super class, sub class, and interface relationships within the classes. All the custom panels extended the JPanel class, so the methods of the JPanel could be used within our classes. The Listener interfaces were also used for the controller classes, so they were able to listen to all the commands within the panel. Additionally, layouts were immensely useful for formatting all the panels created. The most used layout was the Border Layout since it allowed for quick implementation of different panels.

Finally, there is a test patient included into the system since it can be a bit cumbersome to input every single field into the system. This can be used to create new visits that can be then stored in the visit list.

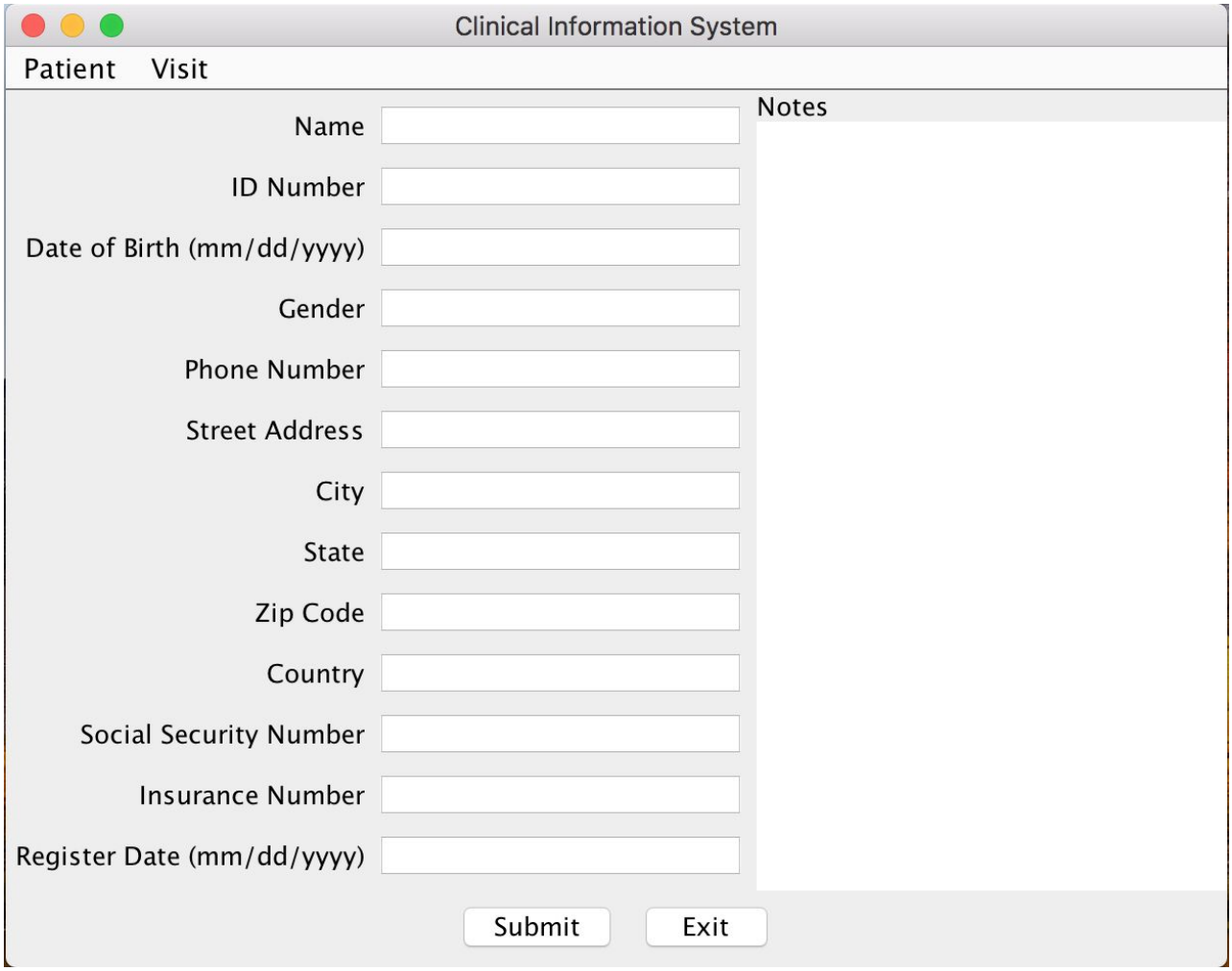
User Interface

The largest change for the UI for the project is the replacement of the Main Menu panel with a menu bar instead. It was decided to do so since it is much easier for the user to be able to navigate throughout the different actions within the application. They no longer have to back all the way to the main menu, and it is always visible what the user can perform. For the most part, the implementation of the different panels is similar to the design with only minor tweaks.

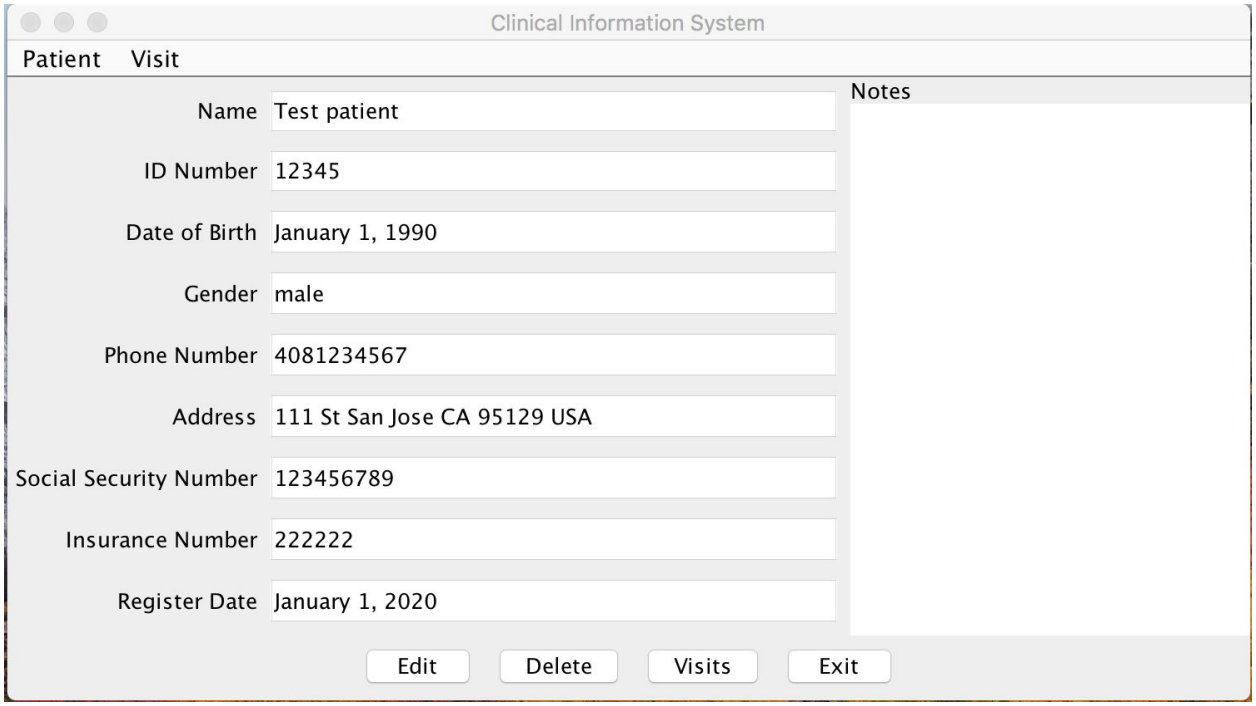
Log In Panel


Clinical Information System
Patient
Visit
Username:
Password:
Log In

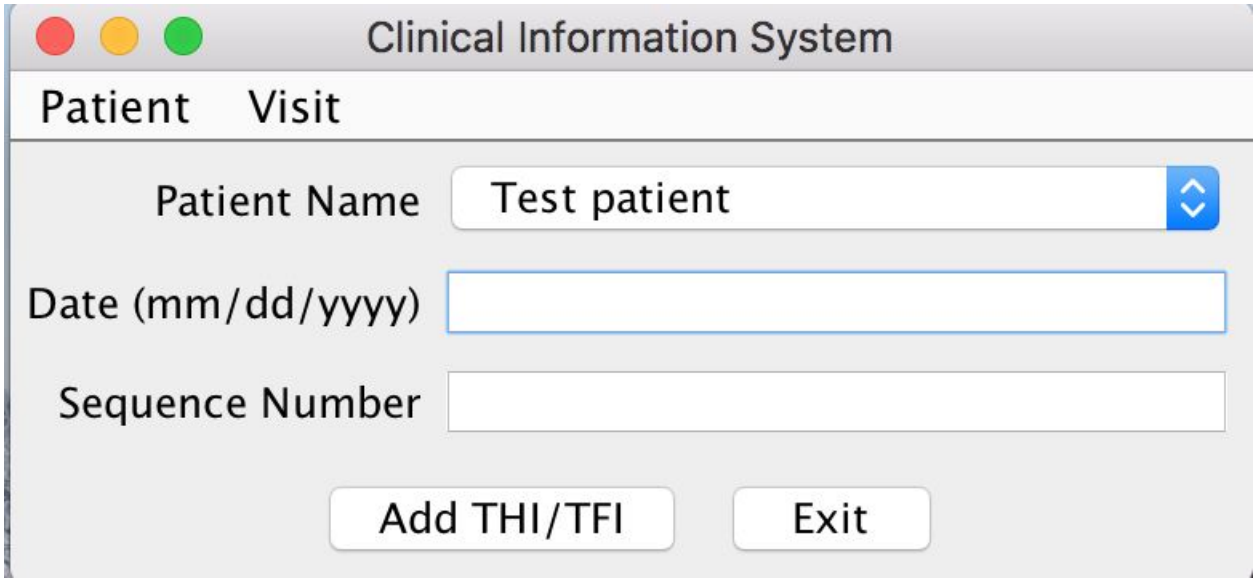
Add Patient Panel



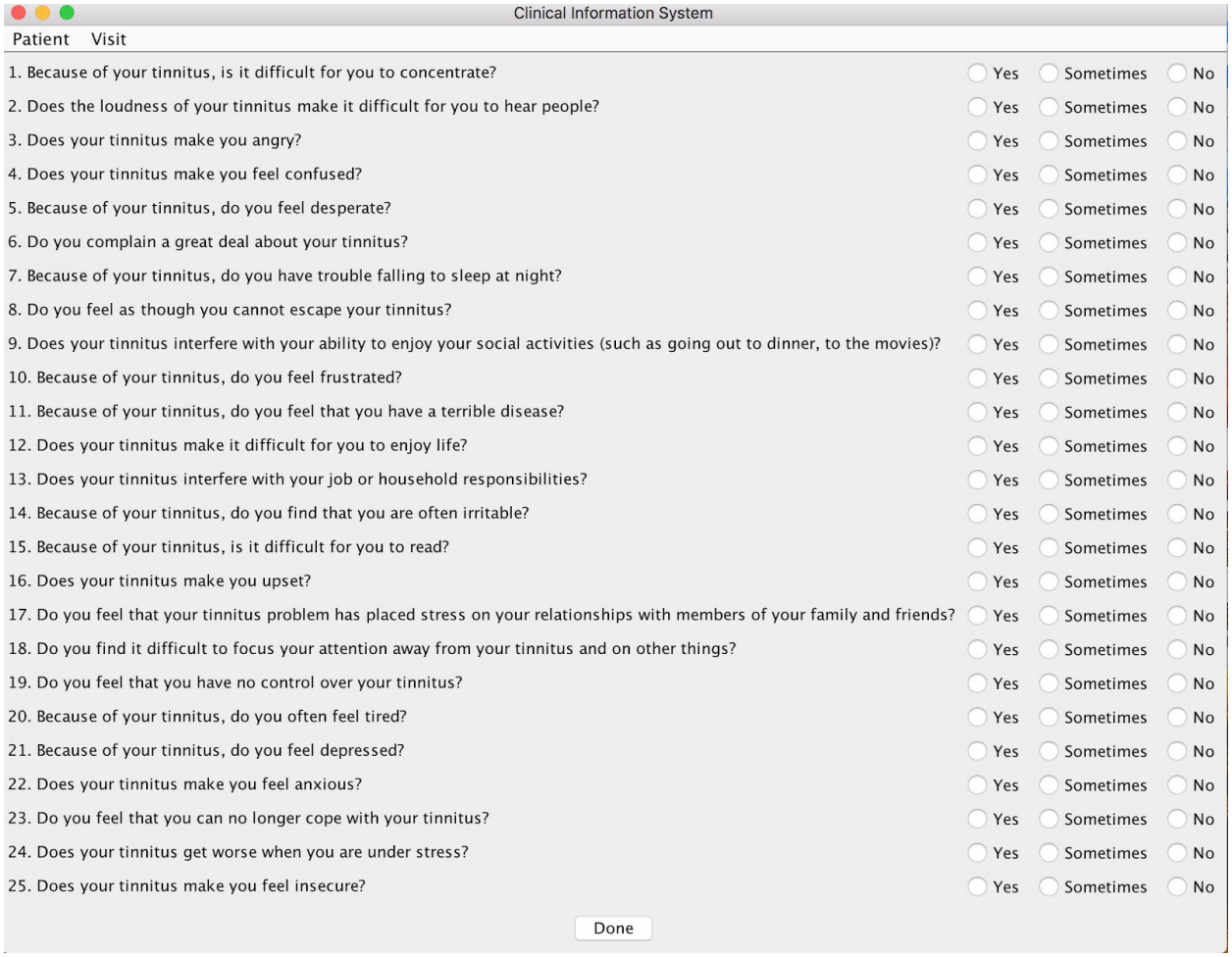
Patient Panel



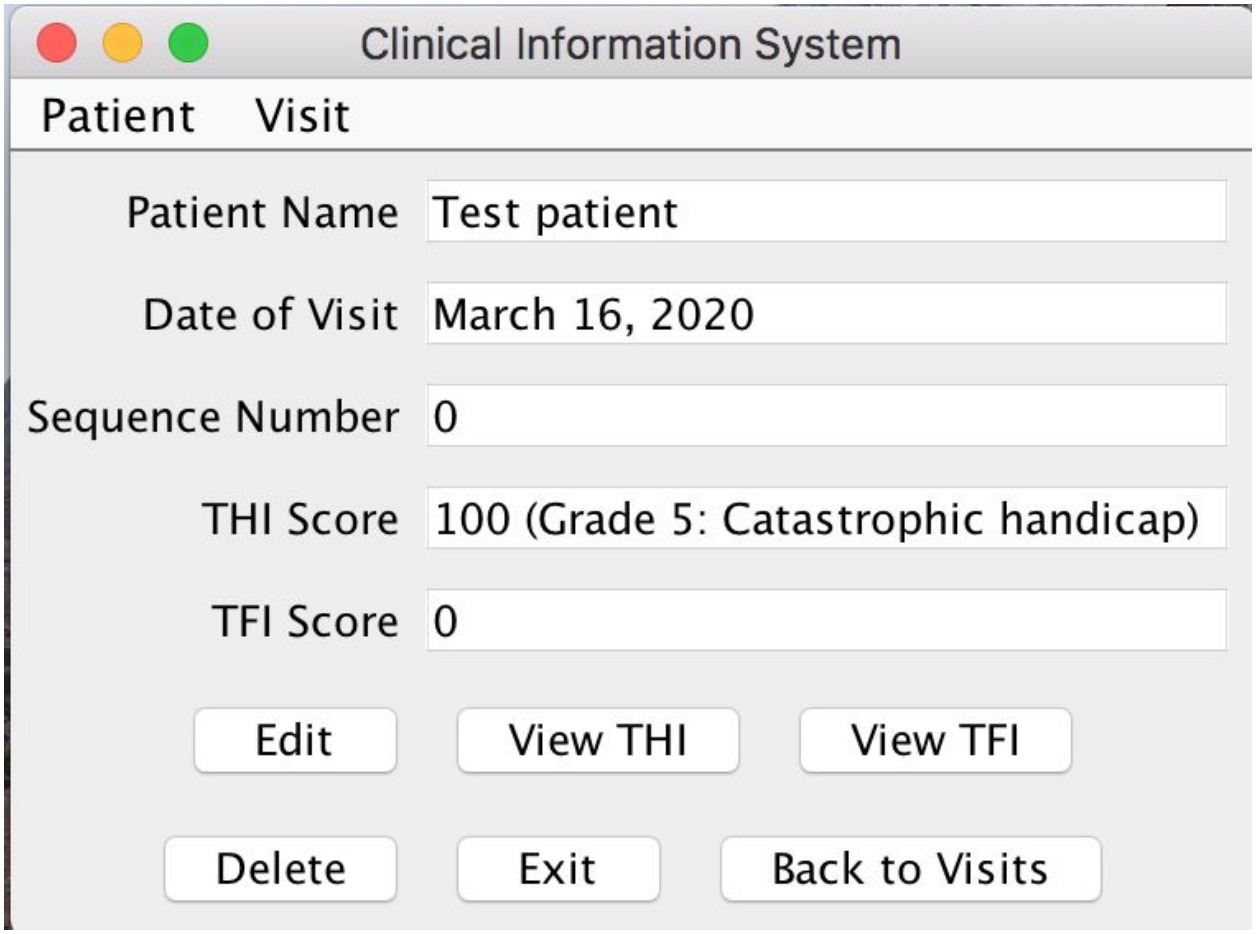
Add Visit Panel



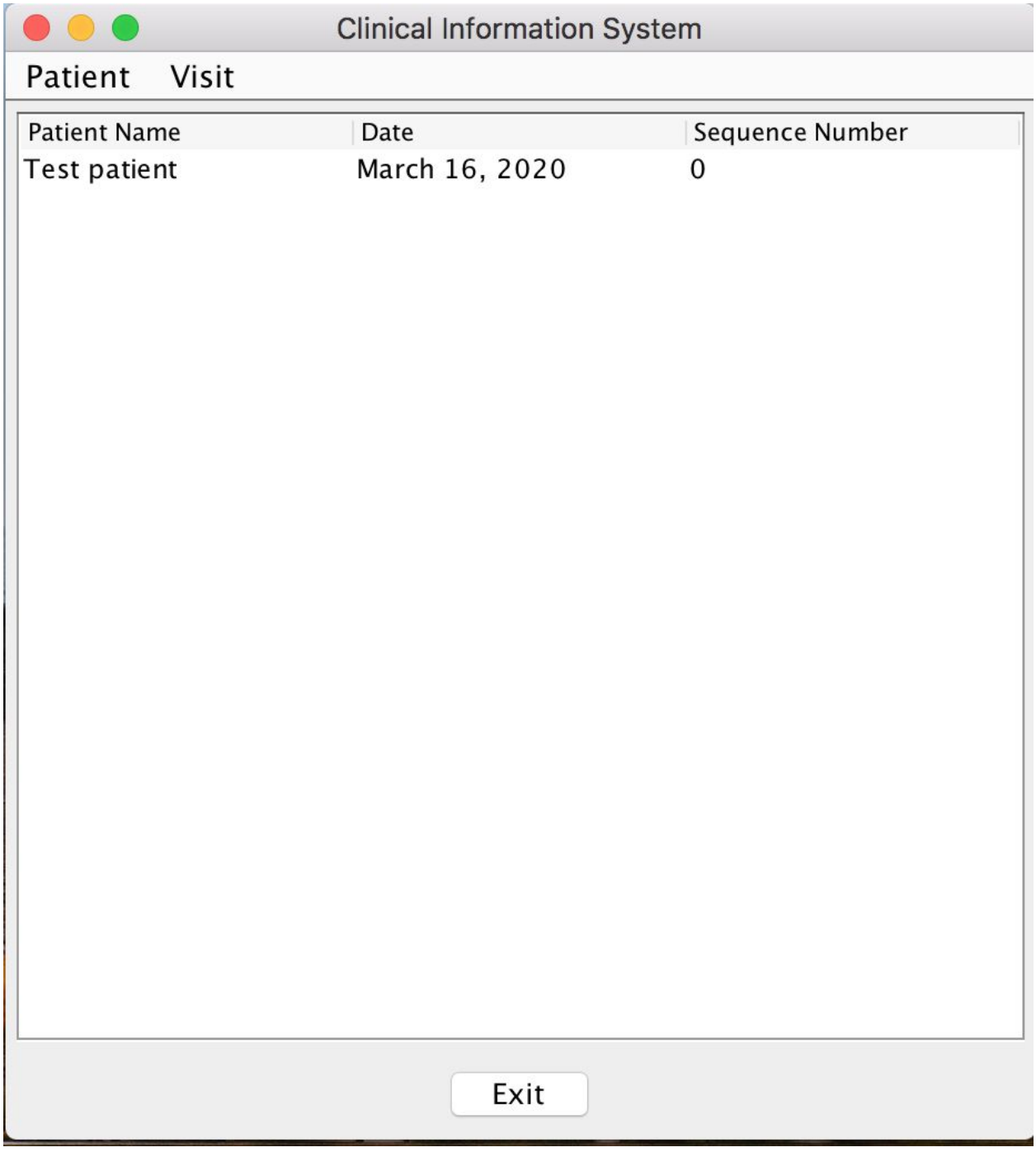
THI Questionnaire Panel



Visit Panel

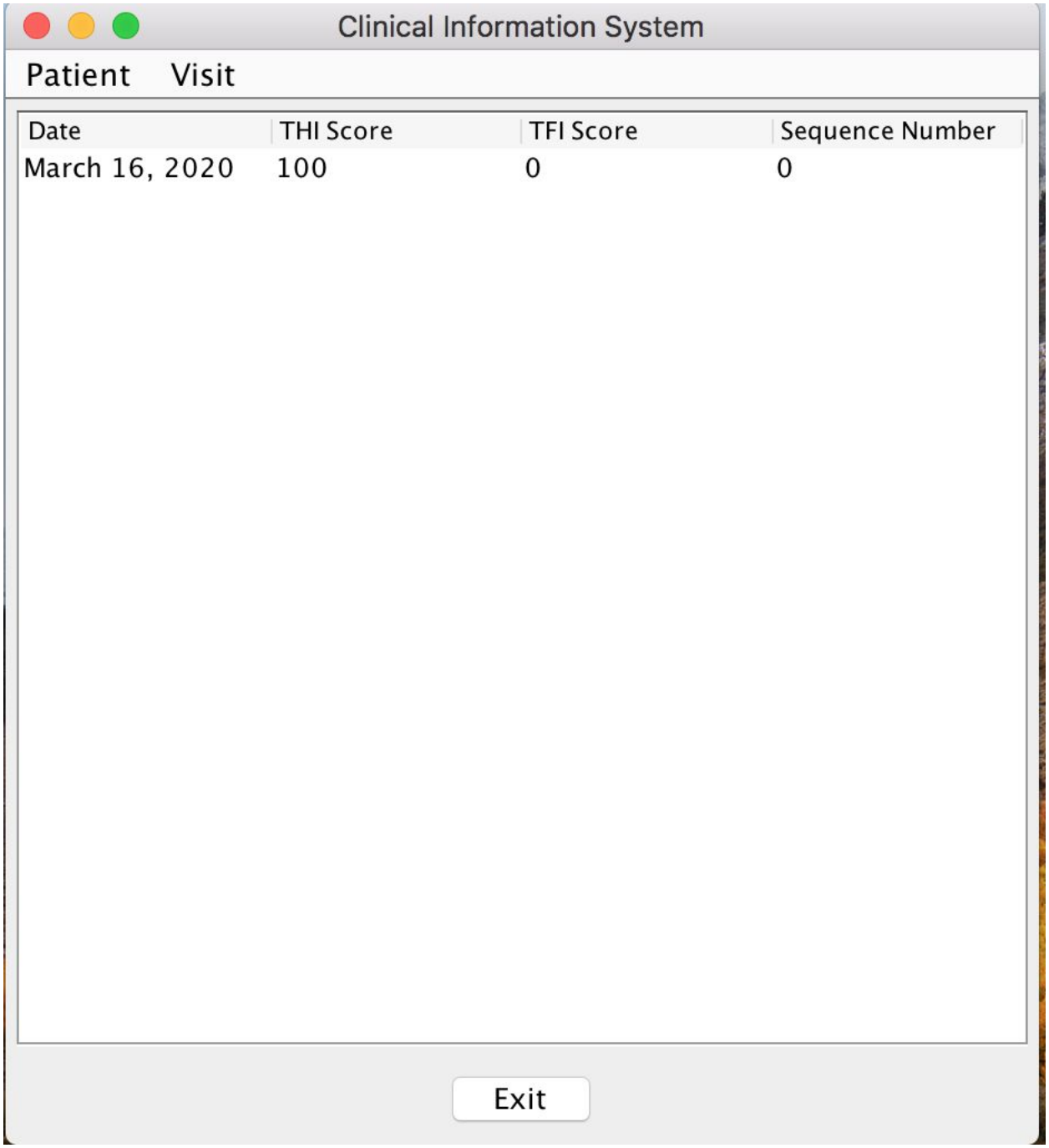

Clinical Information System
Patient
Visit
Patient Name
Test patient
Date of Visit
March 16, 2020
Sequence Number
0
THI Score
100 (Grade 5: Catastrophic handicap)
TFI Score
0
Edit
View THI
View TFI
Delete
Exit
Back to Visits

Visit List Panel



Patient List Panel

Visit List for a certain Patient Panel



References

Oracle (2008) SpringUtilities.java source code (Version 1.4)[Source Code]

https://docs.oracle.com/javase/tutorial/displayCode.html?code=https://docs.oracle.com/javase/tutorial/uiswing/examples/layout/SpringGridProject/src/layout/SpringUtilities.java