

Florida International University
Knight Foundation School of Computing and Information Sciences

Software Engineering Focus

Final Deliverable

Project Title: Cancer Outcome and Recurrence Prediction Tool

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Abstract

This project integrates machine learning with web programming to create a web-based tool for predicting cancer outcomes and recurrence. The primary focus of our team has been the development of the web application, which is designed to accept a variety of patient information including demographics, medical history and other inputs through a user-friendly interface. The tool uses these inputs to generate predictions based on various variables such as treatment type (surgery, radiation, etc.), and parameters (treatment rounds, dosage, etc.).

The web-based platform aims is to assist doctors and physicians by providing real-time recommendations for primary treatment and maintenance therapy. While utilizing uterine cancer data, the scope of the tool will eventually broaden to encompass additional cancer types, enhancing its utility and impact.

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INTRODUCTION

Current System

As this is a new project, development was initiated with no pre-existing systems. Other approaches to cancer treatment tend to rely heavily on historical data and clinical experience, which often utilizes a generalized treatment protocol. These methods, although sometimes effective, can lack the personalization that is needed for the best patient outcome. Existing systems may use static data sets and predefined rules, which do not adapt well to the dynamic nature of cancer treatment. These systems don't always integrate machine learning algorithms to provide real time and data driven recommendations that are tailored to the individual patient profiles.

Purpose of New System

We are the first step in a long-term project to develop a web-based tool that takes patient demographics, medical history, and other information as input and can then make predictions on cancer outcomes and recurrence based on a variety of variables, such as type(s) of treatments (surgery, radiation, chemo) and treatment parameters (rounds of treatments, dosages, etc.) to provide a clinician with recommendations for primary treatment and maintenance therapy.

USER STORIES

The following section provides the detailed user stories that were implemented in this iteration of the Cancer Outcome and Recurrence Prediction Tool project. These user stories served as the basis for the implementation of the project's features. This section also shows the user stories that are to be considered for future development.

Implemented User Stories

These user stories reflect a focus

1. Implementing Home Page: As a user, I want to be able to see a welcoming home page
2. Login Page and Account Creation: As a user, I want to be able to log in into the system to see my personal data.
3. Create User Dashboard: As a user, I want to see all my personal data on a simple and intuitive user dashboard.
4. Designing Patient Data for Manual Entry: As a user, I want to be able to input patient information to process it.
5. Initial Database set up: As a developer, I need to set up the initial database, so we have a place to store information.
6. Convert Excel data to MongoDB database: As a developer, I want to be able to upload machine learning data into the MongoDB database for use with the application.
7. Patient Search: As a physician, I want to be able to search for a patient in the system to see patient details and update patient information.
8. Prediction Results Page: As a user, I want to see the results of the predicted outcome of a patient.
9. Prediction Tool Page: As a user, I want to input a proposed treatment regimen and receive feedback on the expected patient outcome.
10. Patient Prediction History: As a user, I want to be able to see a log of results of previous predictions for a patient
11. Integrate project components: As a user, I want to be able to navigate across all pages of the web app.
 - Landing Page > Create Account > Login > Landing Page (Logged in)

- Dashboard > New Patient > Manual Entry Form > Dashboard
 - (Logged in) > Prediction Tool > Make Prediction > Prediction Results
12. Set up project on server: As a developer, I want to be able to host the project and web app on a server the product owner will maintain. This server will host the database and web app project.

Pending User Stories

1. Upload Patient Data file
 - As a user, I want to upload patient data into the system to be able to process it.
2. Connect to ML process
 - As a developer, I want to connect an ML algorithm to the system that will predict based on the data.
3. Prediction Progress Bar
 - As a user, I want to be able to see the status of the prediction process.
4. FAQ and About Page
 - As a user, I want to have a place where I can find guidance on how to use the Prediction Tool as well as background information regarding how the tool operates.
5. Configure JSON format for output from the Machine Learning process
 - As a developer, I want to interpret the output from the Machine Learning process and display it on the Prediction Results page.

PROJECT PLAN

This section describes the planning that went into the realization of this project. This project incorporated agile development techniques and as such required the sprints to be planned. These sprint plannings are detailed in the section. This section also describes the components, both software and hardware, chosen for this project.

Hardware and Software Resources

The following is a list of all hardware and software resources that were used in this project:

Hardware

- Linux x64 Server running Ubuntu 22.04.04 LTS

Software

- Node version 18.20.3
- Npm version 10.7.0
- Angular version 17.3.8
- Express version 4.19.2
- MongoDB driver 6.6.2
- Nginx version 1.18.0 (Ubuntu)

Sprints Plan

Sprint 1 Planning Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 10:00 Am

End time: 10:30 Am

After discussion, the velocity of the team was estimated to be 35 story points.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

The team members indicated their willingness to work on the following user stories.

- Alexis Diaz
 - User Story 2: Login Page and Account Creation: As a user, I want to be able to log in into the system to see my personal data.

- User Story 4: Upload Patient Data file: As a user, I want to upload patient data into the system to be able to process it.
- Joshua Andres Fernandez
 - User Story 1: Implementing Home Page: As a user, I want to be able to see a welcoming home page
 - User Story 3: Create User Dashboard: As a user, I want to see all my personal data on a simple and intuitive user
- Sebastian Galloway
 - User Story 9: Patient Search: As a physician, I want to be able to search for a patient in the system to see patient details and update patient information.
- Michelle Ramos Pacheco
 - User Story 5: Designing Patient Data for Manual Entry: As a user, I want to be able to input patient information to process it.
 - User Story 8: Prediction Progress Bar: As a user, I want to be able to see the status of the prediction process.
- Raul Pena
 - User Story 6 Initial Database set up: As a developer, I need to set up the initial database, so we have a place to store information.
 - User Story 7 Connect to ML process: As a developer, I want to connect an ML algorithm to the system that will predict based on the data.

Sprint 2 Planning Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 10:00 Am

End time: 10:30 Am

After discussion, the velocity of the team was estimated to be 35 story points.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

The team members indicated their willingness to work on the following user stories.

- Alexis Diaz
 - User Story 4: Upload Patient Data file: *As a user, I want to upload patient data into the system to be able to process it.*
- Joshua Andres Fernandez
 - User Story 3: Create User Dashboard: *As a user, I want to see all my personal data on a simple and intuitive user dashboard.*
- Sebastian Galloway

- User Story 10: Convert Excel data to MongoDB database: *As a developer, I want to be able to upload machine learning data into the MongoDB database for use with the application.*
- Michelle Ramos Pacheco
 - User Story 8: Prediction Progress Bar: *As a user, I want to be able to see the status of the prediction process.*
- Raul Pena
 - User Story 7: Connect to ML process: *As a developer, I want to connect an ML algorithm to the system that will predict based on the data*

Sprint 3 Planning Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 10:00 Am

End time: 10:30 Am

After discussion, the velocity of the team was estimated to be 35 story points.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

The team members indicated their willingness to work on the following user stories.

- Alexis Diaz
 - User Story 12: Prediction Tool Page: *As a user, I want to input a proposed treatment regimen and receive feedback on the expected patient outcome.*
- Joshua Andres Fernandez
 - User Story 14: FAQ and About Page: *As a user, I want to have a place where I can find guidance on how to use the Prediction Tool as well as background information regarding how the tool operates*
- Sebastian Galloway
 - User Story 15: Set up project on server: *As a developer, I want to be able to host the project and web app on a server the product owner will maintain. This server will host the database and web app project.*
- Michelle Ramos Pacheco
 - User Story 13: Patient Prediction History: *As a user, I want to be able to see a log of results of previous predictions for a patient*
- Raul Pena
 - User Story 11: Prediction Results Page: *As a user, I want to see the results of the predicted outcome of a patient.*

Sprint 4 Planning Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 10:00 Am

End time: 10:30 Am

After discussion, the velocity of the team was estimated to be 35 story points.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

The team members indicated their willingness to work on the following user stories.

- Alexis Diaz
 - User Story 17: Configure JSON format for output from the Machine Learning process: *As a developer, I want to interpret the output from the Machine Learning process and display it on the Prediction Results page*
- Joshua Andres Fernandez
 - User Story 16: Configure JSON format for input values to Machine Learning process: *As a developer, I want to provide the input values from the data entry forms to the Machine Learning process to predict patient outcomes*
- Sebastian Galloway
 - User Story 19: Integrate project components Part 2: *As a user, I want to be able to navigate across all pages of the web app. If logged in: Dashboard > New Patient > Manual Entry Form > Dashboard*
- Michelle Ramos Pacheco
 - User Story 18: Integrate project components Part 1: *As a user, I want to be able to navigate across all pages of the web app. Landing Page > Create Account > Login > Landing Page (Logged in)*
- Raul Pena
 - User Story 20: Integrate project components Part 3: *As a user, I want to be able to navigate across all pages of the web app. Landing Page (Logged in) > Prediction Tool > Make Prediction > Prediction Results*

Sprint 5 Planning Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 10:00 Am

End time: 10:30 Am

After discussion, the velocity of the team was estimated to be 35 story points.

The product owner chose the following user stories to be done during the next sprint. They are ordered based on their priority.

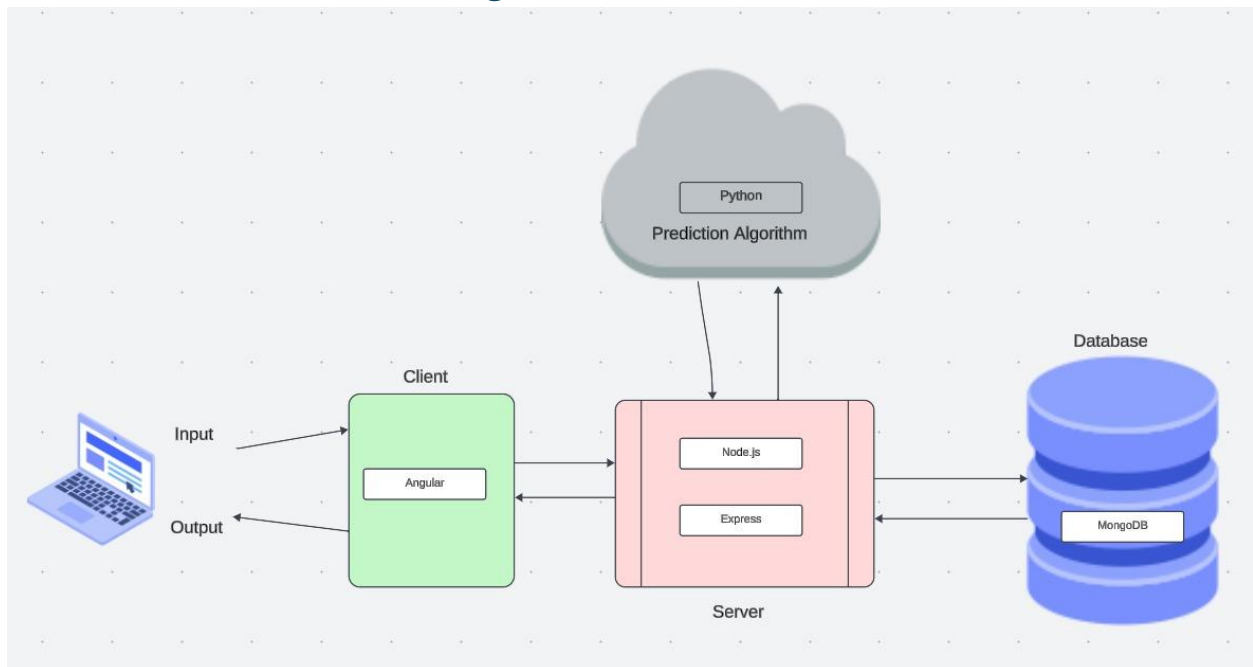
The team members indicated their willingness to work on the following user stories.

- Alexis Diaz
 - User Story 23: Integrate project components Part 6: *As a user, I want to be able to navigate across all pages of the web app. - Prediction Results*
- Joshua Andres Fernandez
 - User Story 24: Integrate project components Part 7: *As a user, I want to be able to navigate across all pages of the web app. - Patient Prediction History*
- Sebastian Galloway
 - User Story 25: Integrate project components Part 8: *As a user, I want to be able to navigate across all pages of the web app. Update code to use production database and ensure validators of data*
- Michelle Ramos Pacheco
 - User Story 21: Integrate project components Part 4: *As a user, I want to be able to navigate across all pages of the web app. - Manual Entry Form to database*
- Raul Pena
 - User Story 22: Integrate project components Part 5: *As a user, I want to be able to navigate across all pages of the web app. - Prediction Tool*

SYSTEM DESIGN

This section contains information on the design decisions that went into this project. The architecture patterns are outlined and explained. The entire system is shown in a package diagram and the subsystems are explained. Finally, the design patterns used in the project are discussed.

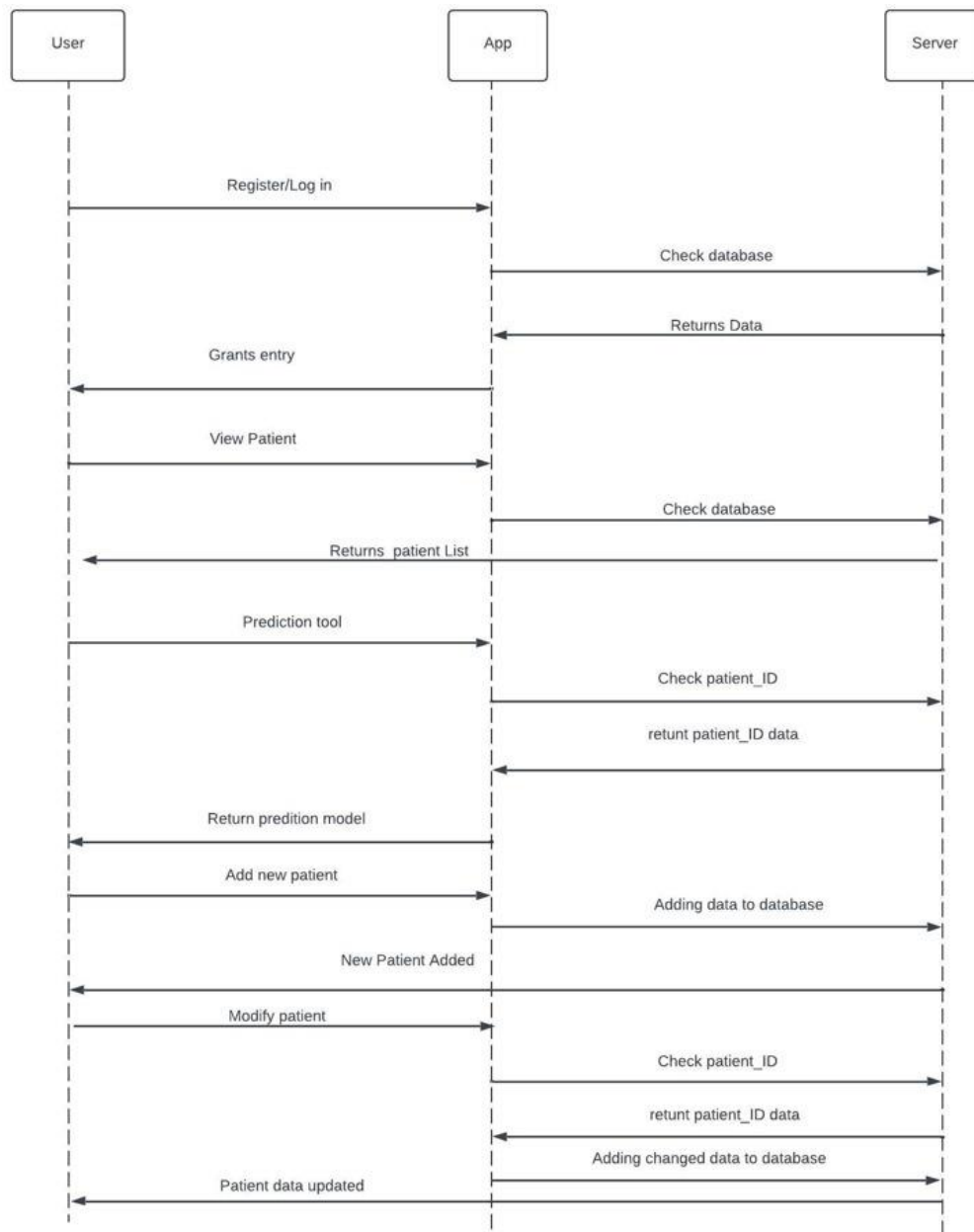
Architectural Patterns & Design Patterns

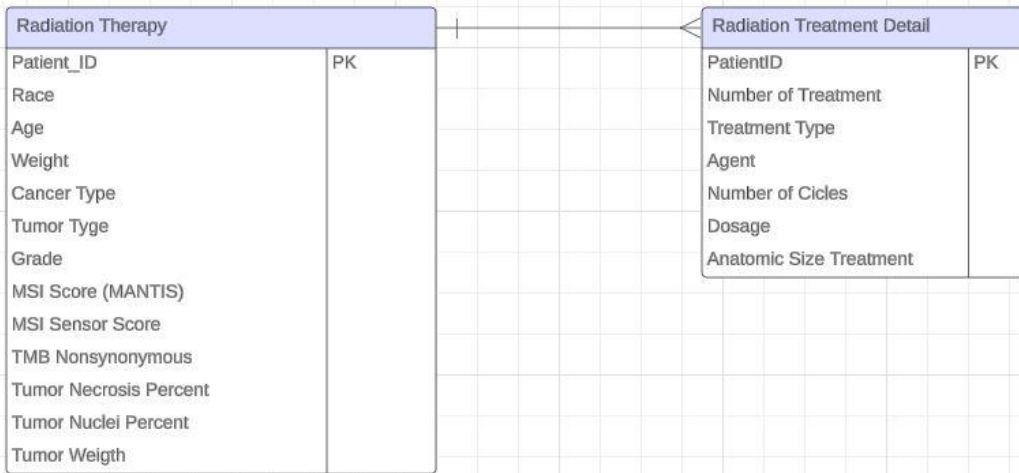


FIGMA MOCKUP

FIGMA PROTOTYPE

UML Diagrams





Appendix A - Sprint Review Reports

Sprint 1 Review Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena
Start time: 12:00 PM
End time: 1:00 PM

After a show and tell presentation, the implementation of the following user stories were accepted by the product owners: All.

User Story 1: Implementing Home Page

User Story 2: Login Page and Account Creation

User Story 6: Initial Database set up

User Story 5: Designing Patient Data for Manual Entry

User Story 9: Patient Search

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

User Story 3: Create User Dashboard

User Story 4: Upload Patient Data file

User Story 7: Connect to ML process

User Story 8: Prediction Progress Bar

Sprint 2 Review Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 1:00 PM

End time: 2:00 PM

After a show and tell presentation, the implementation of the following user stories were accepted by the product owners: All.

- User Story 10: Convert Excel data to MongoDB database
- User Story 3: Create User Dashboard
- User Story 4: Upload Patient Data file
- User Story 7: Connect to ML process
- User Story 8: Prediction Progress Bar

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

∄ None

Sprint 3 Review Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 5:00 PM

End time: 6:00 PM

After a show and tell presentation, the implementation of the following user stories was accepted by the product owners:

- User Story 15: Set up project on server
 - User Story 12: Prediction Tool Page
 - User Story 11: Prediction Results Page
 - User Story 13: Patient Prediction History
 - User Story 14: FAQ and About Page

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

∄ None

Sprint 4 Review Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 5:00 PM

End time: 6:00 PM

After a show and tell presentation, the implementation of the following user stories was accepted by the product owners:

- User Story 16: Configure JSON format for input values to Machine Learning process
- User Story 17: Configure JSON format for output from the Machine Learning process
- User Story 18: Integrate project components Part 1

- User Story 19: Integrate project components Part 2
- User Story 20: Integrate project components Part 3

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

∄ None

Sprint 5 Review Meeting Minutes

Attendees: Alexis Diaz, Joshua Andres Fernandez, Sebastian Galloway, Michelle Ramos Pacheco, Raul Pena

Start time: 5:00 PM

End time: 6:00 PM

After a show and tell presentation, the implementation of the following user stories was accepted by the product owners:

- User Story 21: Integrate project components Part 4
- User Story 22: Integrate project components Part 5
- User Story 23: Integrate project components Part 6
- User Story 24: Integrate project components Part 7
- User Story 25: Integrate project components Part 8

The following ones were rejected and moved back to the product backlog to be assigned to a future sprint at a future Spring Planning meeting.

∄ None

Appendix B - User Manuals, Installation/Maintenance Document, Shortcomings/Wishlist Document and other documents

TO INSTALL AND MAINTAIN:

Download the files and open the directory in your preferred IDE.

Open the terminal and navigate to the 'CancerPredictionTool/code/client' directory.

Run the command 'npm install' to download and install all required dependencies.

Now you should be ready to update the code.

TO RUN THE WEB APP LOCALLY:

Open a terminal window and navigate to the 'CancerPredictionTool/code/server' directory.

Run the command 'npx ts-node src/server.ts' to start the local server on port 5200.

Open a terminal window and navigate to the 'CancerPredictionTool/code/client' directory.

Run the command 'ng serve -o' to build the solution and open the web app that is hosted locally.

TO PUSH CHANGES TO THE PRODUCTION WEB SERVER:

1. Open a terminal window and navigate to the 'CancerPredictionTool/code/client' directory.
2. Run the command 'ng build' to build the solution. The files you need are in the 'CancerPredictionTool/code/client/dist' directory.
3. Connect to the web server via SSH and SFTP to copy all of the files in the 'CancerPredictionTool/code/client/dist/browser' directory to the '/lclhome/projects/cancer' directory. The updated web site should be live at <https://cape.cs.fiu.edu>.