EMR

(Electronic Medical Records)

Submitted by: Team 1

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Discipline: Health Informatics & Software Engineering
Due Date: April 18, 2021

Declaration of Sole Authorship

We,Team 1 of section 004 of course COMP231-Software Development Project 1, confirm that this work submitted for assessment is our own and is expressed in our own words. Any uses made within it of the works of any other author, in any form (ideas, equations, figures, texts, tables, programs), are properly acknowledged at the point of use. A list of the references used is included.

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Abstract

Traditionally, patient health records are captured on paper forms. It results in an inefficient management of health records which are hard to maintain and use. A patient's data may not be available in a timely manner to support proper diagnosis and treatment. It may lead to delayed diagnosis and treatment. Therefore, there is an urgent need to develop a new software system to enable patient data management on electronic devices. Such a system will be termed as an EMR (Electronic Medical Records) system. Our proposed solution will enable both clinicians and patients to manage patient medical records in an efficient and convenient way. In future, we will implement telehealth and augmented reality features to assist in improved real time diagnosis, monitoring and education. It will open doors of new opportunities by allowing patients to contact their doctors remotely from home without any need for long travel, saving time and money and vice versa. We have a team of motivated software developers capable of achieving the challenging and demanding dream of developing EMR. There are competitors such as Telus health among others already in the arena. But we are confident to take a lead as our software will offer features like none other such as interoperability and telehealth features.

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1.0 INTRODUCTION

Traditional Medical Record keeping has to do with a lot of paperwork and keeping track of a patient’s history is difficult. Hence, our team has come up with a solution to turn these medical records to electronic records.

Our goal is to provide the clinics with an integrated online form for the office staff, the nurses and the Doctors use, which help them to keep track of a patient's health records such as new registration of doctors, nurses according to their clinics and patients according to their family physicians. Deliverables also include new and follow up appointments, reports from lab works and specialists to whom the patients were referred to. Our solution excludes the payment system for this SDLC.

The above solution is paperless and hence, environment friendly. It saves time and money by being able to retrieve and track the patient’s records quickly and helps in reducing duplication. In future we can improve this application by introducing telehealth and augmented reality which is currently out of the scope for this development.

2.0 METHODOLOGY AND RESULTS

2.1 Literature Review

At present the clinics are using papers to track their patient’s records and have had problems in tracking the lab works and often have ended in duplication of tests or losing records which are manually handled by file keeping. The clinic also spends a lot on printing patients' records. Tracking and maintenance has become an issue as these records physically need space and are easily misplaced.

2.2 Proposed Solution

This software solution is going to be a platform-independent solution which can be used on mac, windows and mobile OS devices. The solution will be cost effective and the cloud based solution would be available on every device supporting a web browser. Figure 1 below represents our proposed solution diagram. The product will be able to manage and access patient data in real time for diagnosis. There would be a check on the data security by electronic medical records providing required information to selective stakeholders.

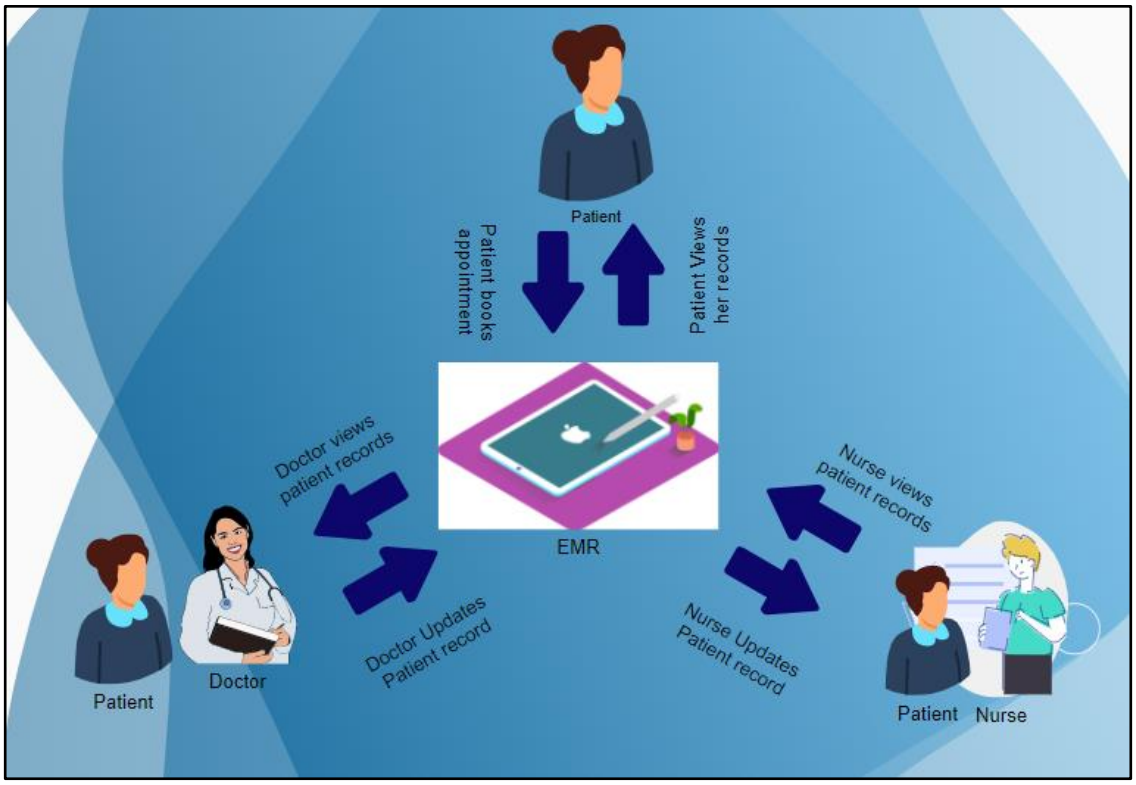


Figure 1: Electronic Medical Records System

Executive Summary

Traditionally, patient health records are captured on paper forms. It results in an extremely inefficient management of health records which are hard to maintain and use. A patient's data may not be available in a timely manner to support proper diagnosis and treatment. It may lead to delayed diagnosis and treatment leading to issues or miseries faced by a patient. Therefore, there is an urgent need to develop a new software system to enable patient data management on electronic devices. Such a system will be termed as an EMR (Electronic Medical Records). Our proposed solution, EMR (Electronic Medical Records) will enable both clinicians and patients to manage patient medical records in an efficient and convenient way. In future, we will implement telehealth and augmented reality

features to assist in improved real time diagnosis, monitoring and education. It will open doors of new opportunities by allowing patients to contact their doctors remotely from home without any need for long travel, saving time and money and vice versa. We have a team of motivated software developers capable of achieving the challenging and demanding dream of developing EMR. There are competitors such as Telus health among others already in the arena. But we are confident to take a lead as our software will offer features like none other such as interoperability and telehealth features.

Business Objectives

- **Business Need/Opportunity/Objectives**

  There is an urgent need to develop a software system - Electronic Medical Records to capture and maintain patient data electronically on digital devices such as computers, tablets and smartphones.

  - It will manage patient health data electronically in a secured and efficient manner.
  - It will allow data retrieval from anywhere.
  - It will lead to fast and accurate diagnosis and treatment of patients to ensure speedy recovery.
  - It will be a cost effective Solution (available for a reasonable subscription price) hosted on a cloud server.
  - It will help eliminate duplicate lab tests and procedures

- **Product Description (Solution)**

Our software solution (EMR - Electronic Medical Records) will be cross platform and will be available on Mac, Windows and all mobile devices running IOS. Cloud based solutions will be available on every device capable of running a web browser. It will be a cost effective and efficient subscription based service available 24/7/365.

It will provide the following benefits:

- Ability to manage Patient Medical Records on computers and similar digital devices
- It will result in real time access access to Patient data to help fast and accurate diagnosis and treatment
- Electronic Medical Records will ensure data security and available only to the relevant stakeholders
- Ability to register a healthcare provider and patient online
- Ability to schedule Physician's office visit online
- Ability to interact online with a doctor or a patient
- reduce / eliminate travel time
- Reduce cost of treatment by eliminating duplicate lab tests
- Timely contact between patient and healthcare provider
- Patient education
- Data security and Privacy ensured

- **Deliverables**

  Deliverables include:

  - An EMR system prototype available for patients and healthcare providers
  - Database schema / information
  - EMR Software documentation

Project Description

- **Scope**

  Includes**:**
  - User Management

    - Add / Update Doctor
    - Add / Update Nurse
    - Add / Update Specialist Doctor
    - Add / Update Patient
    - Add Clinic
- Add doctor to a clinic
- Add a patient to family doctor
- Schedule doctor’s office visit
- Create Lab test request
- Create Diagnosis report
- Create Treatment for a patient
- Create prescription
- Refer a patient to a specialist
- Create follow up visit for a patient

Does Not Include:

- Telehealth features
- Augmented Reality
- Video Conferencing

- **Completion Criteria**

    - Completed Software prototype for EMR application
    - Software documentation

Measures of Project Success

- User friendly SW prototype cloud based web application

Stretch Factor

Cross platform, cloud based EMR software application available for use from anywhere. Our team aims to develop the prototype using FileMaker / NodeJS Express technology platform which is a leader in rapid application software development.

Project Approval Form

I, Bob Pajkowski, have reviewed the information contained in this document and approve the project proposal.

Bob Pajkowski	February 5, 2021
Signature	Date

2.3 User Role Modelling

2.3.1 Brainstorm and Group

Figure 2 below shows the brainstorming of user roles for the EMR system.

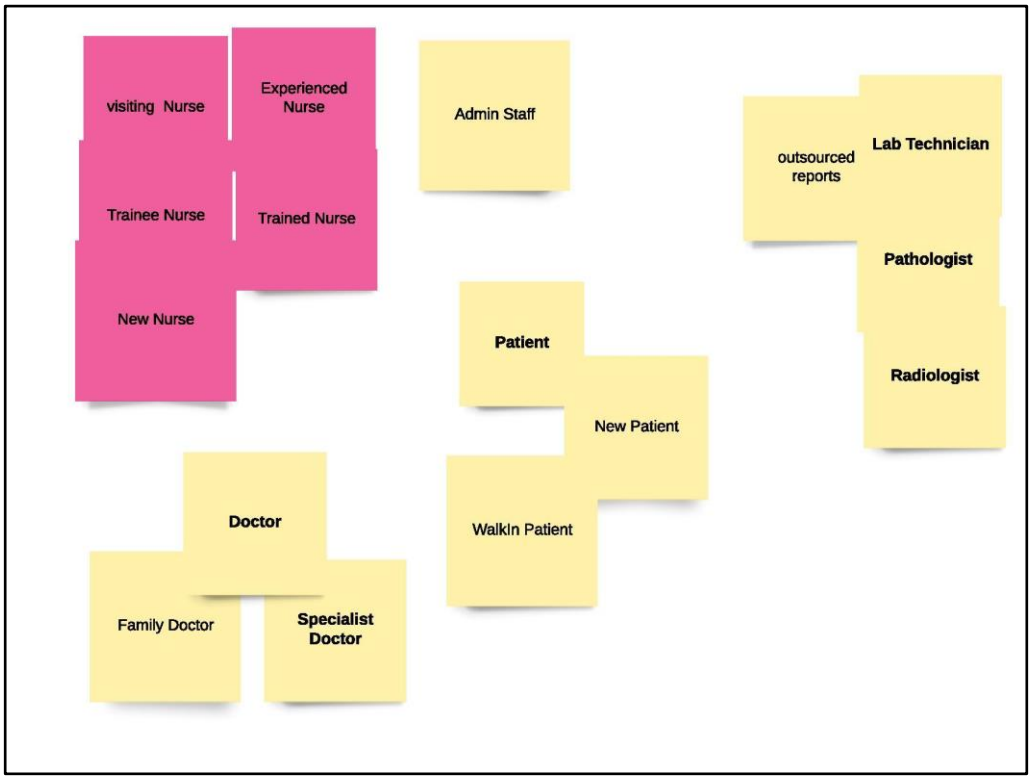


Figure 2: Organizing the user role cards..

We brainstormed all the kinds of user roles in the clinics. We also came up with user roles such as Pathologist, Radiologist and Lab technician which at this point are out of the scope.

The below is the link to our recorded session on brainstorming user roles for EMR:

https://drive.google.com/file/d/13cq0uKRHE_NddiB4BMU1TqWROvZPqXXg/vie

w?usp=sharing

We then consolidated by removing duplicate roles after identifying their usage with the EMR app.

From this session, the unconsolidated roles from the group are,

- Patient - new patient, walk-in patient.
- Doctor - Family Doctor, Specialist.
- Nurse- Trainee Nurse, Trained Nurse, Experienced Nurse, Visiting Nurse, New Nurse
- Admin

2.3.2 Consolidated User Roles

Figure below shows the consolidated user roles (see Figure 3).

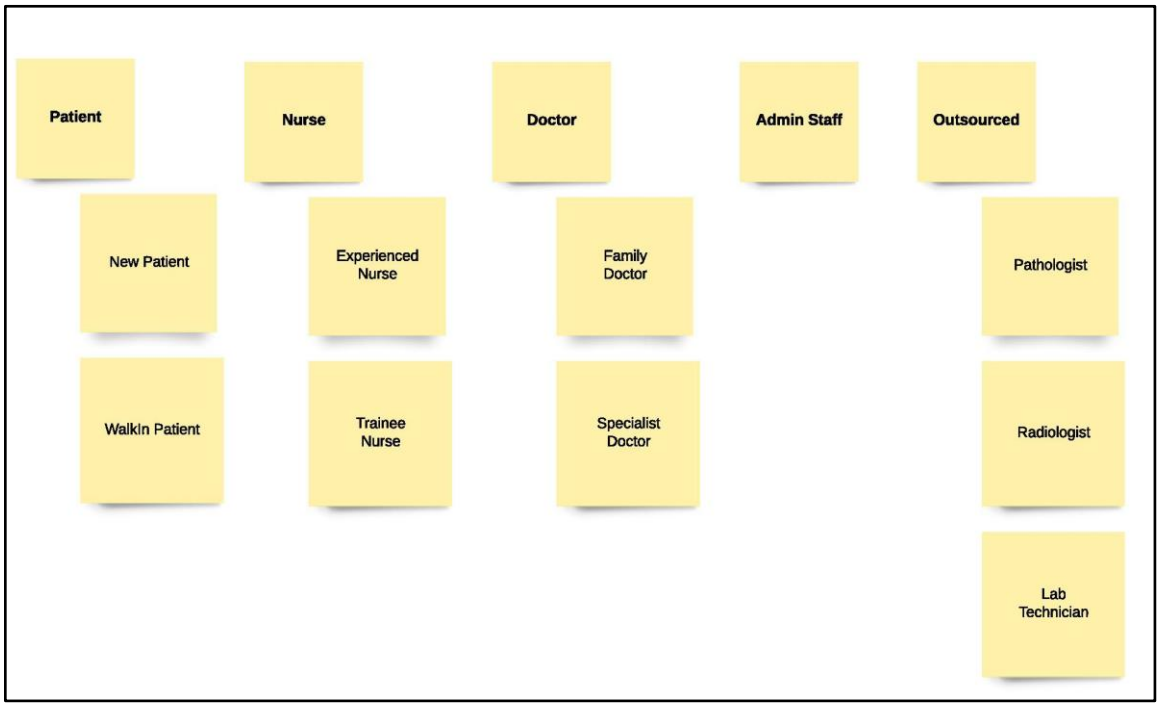


Figure 3: The consolidated role cards [1].

We then consolidate the roles, after removing the overlapping user roles these are the roles, we concluded upon which are within the scope of the app we are designing.

- New Patient
  Explanation: A new patient will use the EMR software system to register and select an available doctor as a family doctor. Once registered, a patient will book an appointment with a family doctor. Then, the patient will visit the clinic and will undergo physical examination by an on duty nurse and family doctor for diagnosis and treatment . Patient will be able to view his health data.

- Walk-in Patient
  Explanation: A first time walk-in patient will use the EMR software system to register. The patient will visit the clinic and will undergo physical examination by an on duty nurse and any available doctor for diagnosis and treatment. Patient will be able to view his health data.

- Family Doctor
  Explanation: A Family doctor is associated with selected patients. He verifies physical exams done by a nurse and, in addition, performs further clinical tests to evaluate a patient's health condition in order to arrive at some diagnosis. He may recommend required lab tests or refer the patient to a specialist doctor to establish correct diagnosis. Once diagnosis is done, he will order a medical prescription and/or required medical procedures for patient treatment. Patient medical data will become part of

the EMR software system.

- Specialist Doctor
  Explanation: The specialist doctor will receive a referral note from a family doctor. Upon patient visit, the specialist doctor will examine a patient to help diagnose a specific problem or disease. The specialist doctor will use EMR software to capture patient health data.

- Trainee Nurse, Experienced Nurse
  Explanation: A nurse will use EMR software to enter patient physical examination data. A Trainee nurse is someone new, so as most of the duties overlap from new nurse and visiting nurse, we made a single card as Trainee Nurse. Similarly, trained and experienced categories decided on a single card as Experienced nurse instead of two cards.

- Admin
  Admin deals with the software operation and authorizing access levels to various employees in the clinic.

2.3.3 Description of User Roles and Persona

For each consolidated role from the above section 2.3.2, the Table 1 below details:

- The frequency with which the user will use the software.
- The user's level of expertise with the domain.
- The user's general level of proficiency with computers and software.
- The user's level of proficiency with the software being developed.

- The user's general goal for using the software.

Table 1: User Roles and Personas.

Q#	Question	User Roles			
		Patient	**Doctor**	**Nurse**	**Admin (Out of Scope)**
1	Frequency of SW use	as needed	Daily use	Daily use	Daily Use
2	Level of expertise within his/her domain	NA	in depth knowledge of Health Care domain	knowledge of nursing profession	Knowledge of day to day clinical operations
3	General level of proficiency with computers and software	general user	general user	general user	general user
4	Level of proficiency with the software being developed	New / Familiar User	New / Familiar User	New / Familiar User	New / Familiar User
5	General goal for using the software	Registration with EMR System	Registration with EMR System	Registration with EMR System	Management of the clinical operations
		Search Clinic	Search and View Appointments	Search Appointments	User management,
		Search and Select a family doctor	View Physical Exam Date	Conduct Physical Exam	appointment management
		Ease of tracking and user experience	Ease of tracking and user experience	Ease of tracking and user experience	Ease of tracking and user experience

2.3.4 Additional Documentation

The brainstorming session was conducted online with the help of LucidChart tool.

Below is the link to the User Roles Brainstorming Session:
Shared folder: COMP231-W2021-Sec004-Team1 > User Role Modeling > File Name
File Name: COMP231_SEC004_Team1_User Roles Brainstorming.mp4
Link to the recorded Video in the shared folder:
https://drive.google.com/file/d/13cq0uKRHE_NddiB4BMU1TqWROvZPqXXg/view?usp=sharing.

2.4 Release 1.0

2.4.1 User Stories

There were too many stories when we started to brainstorm the user stories according to the user roles which we had focused on. We did a few low-fidelity user stories on doctor, admin and patient user roles. After the session, we found the complexity of the development increased with the admin role. Hence, the scope of the project was refined by excluding the admin user and focusing more on the patient, the doctor and the nurse roles.

Everyone in the group came up with their own idea and then it was evaluated after the recorded session. This kind of approach was chosen as we had problems to have a common meeting session this week. Due to the time constraint and the number of stories that we had come up with, only some of the low-fidelity prototypes that were brainstormed and, it can be found in the word document below:
https://docs.google.com/document/d/1b4kAFuxIzm_GbRkFrJZSQrLezuwv6IdqOwg2jzDTed4/edit

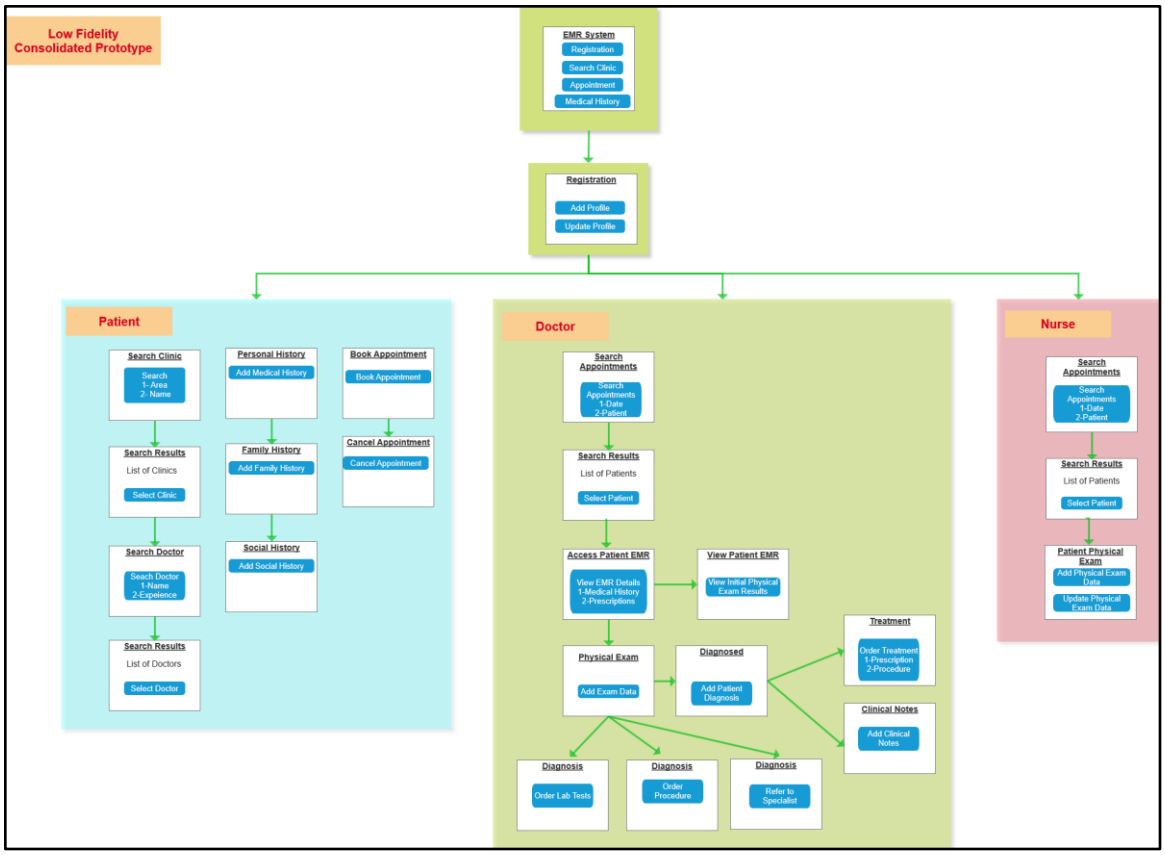


Figure 4: Consolidated low-fidelity prototype.

Additional Details:

We took a different approach to write user stories suiting the requirements of the project. Hence used a spreadsheet document to list the user stories which provided the filtering options based on the column headers.

Below is the link to the Spread Sheets for user stories and their constraints listed.
File Name: COMP231 - S004- Team 1 - User Stories - Winter 2021
Link:
https://docs.google.com/spreadsheets/d/15f0egRbAb5M6iWkU1CgvyWvAv-FUrxTi2sIASDEurhs/edit#gid=0

Priorities User Stories for Release 1 using MoSCoW Rule:

Below are the stories for the product according to the Moscow rule. More information on the user stories can be found on the excel sheet. Link to the excel sheet: https://docs.google.com/spreadsheets/d/15f0egRbAb5M6iWkU1CgvyWvAv-FUrxTi2sIASDEurhs/edit#gid=0

Please note that in the tables below the estimate is 1 ideal hour = 8 hours of a working day.

Table 2: The Must-Have stories for Release 1.0 [1].

User Story	Estimate
A nurse can register with the EMR System.	1
A nurse can access the EMR system to add patient data.	1
A nurse can access the EMR system to update patient data.	1
A patient can register with the EMR System.	1
A patient can view the appointment schedule.	1
A patient can make patient particulars up to date.	1
A doctor can register with the EMR System.	1
A doctor can access the EMR system to update his profile.	1
A doctor can view his daily appointment schedule.	1
All users can view the information about the clinic and its contact information.	1

Table 3: The Should-Have stories for Release 1.0.

User Story	Estimate
A doctor can select the patient who is due next in the queue for a checkup.	1
A doctor is able to add notes and write prescriptions for a checkup that is made on a patient.	1
A doctor can order a prescription for the patient.	2
A doctor is able to select a patient and refer them for lab work.	2
A patient can see the lab results and current diagnosis.	2
A patient can see the current prescription.	1
A doctor can refer his patients to a specialist.	1

Table 4: The Could Have User Stories for Release 1.0

User Story	Estimate
A patient can book an appointment.	1
A patient can cancel the scheduled appointment.	1
A patient can change appointment time to a later date.	1

Table 5: The Won't Have User Stories for Release 1.0

User Story	Estimate
An admin can see a registration request and should be able to book an initial appointment check up for the respective patient with the requested/available doctor.	1

An admin can send a link to the doctor to register himself to the clinic.	1
An admin can send a registration link to the respective nurse.	1
An admin can add new employees to the system.	1
An admin can delete employees that no longer work.	1
An admin can train new staff on software or apps.	2
An admin can set access levels to the staff.	1/2
An admin can send an alert when a new lead comes in.	1/2
An admin can allow view and update of appointments.	2
A patient can pay for the lab tests.	1
A nurse can update lab test results in the system.	1

2.4.2 Additional Documentation

Video Report:

Because of common time constraint complexity all the team members gather at the same time we came up with a different approach to move forward with the project. So, this week our team got together to put forward the numerous ideas, user stories and proposal of prototypes that could be considered for the release plan, it had been an excellent session to understand each other's viewpoints and get synchronised with our thoughts and the development prototype. The link to the video session can be found on User Story Workshop Video.

Link:

https://drive.google.com/file/d/1A3zyjr9UDEnVobWY8wmXLe5pOKT2KhP8/view?usp=sharing

2.4.3 Release Plan 1.0

Product Development RoadMap & Release Plan:

Table 6: Showing the Product Development Roadmap.

Themes	Release 1 Iteration 1: Home and Registration	Release 1 Iteration 2: Login and Landing/ Dashboard	Release 1 Iteration 2: Patient View	Release 1 Iteration 2: Nurse view	Release 1 Iteration 2: Doctor view
User stories	• Home page • Nurse Registration • Patient Registration • doctor registration • Contacts page	• Login for all the users • Landing/dashboard for all the users • edit profile • Nurse and Doctor can view the schedule. • Nurses and doctors can create patient records.	• view next expected appointment • view reports • view prescriptions • view vaccination record • request information	• form to enter preliminary physical examination • search patient. • view patient history	• form to enter physical examination • search patient • order prescription. order lab work. • refer to a specialist. • view patient history
	Week 1	Week 2	Week3	Week 4	Week 5

2.4.3 Release Plan:

Release Plan Date: March 8th, 2021

Product Release Date: April 12th, 2021

Table 7: showing the release plan with iteration 1 and 2

Iteration 1 (2 weeks)	Iteration 2 (2 weeks)
A nurse can register with the EMR System.	A patient can view the appointment schedule.
A nurse can access the EMR system to add patient data.	A doctor can select the patient who is due next in the queue for a checkup.
A patient can register with the EMR System.	A doctor is able to add notes and write prescriptions for a checkup that is made on a patient.
A patient can make patient particulars up to date.	A doctor can order a prescription for the patient.
A doctor can register with the EMR System.	A doctor is able to select a patient and refer them for lab work.
A doctor can access the EMR system to update his profile.	A patient can see the lab results.
A doctor can view his daily appointment schedule.	A patient can see the prescription.
All users can view the information about the clinic and its contact information.	A doctor can refer his patients to a specialist.
	A nurse can access the EMR system to update patient data and preliminary physical examination data.

2.4.4 Iteration Plan (Release 1.0)

Table 8: Measuring the actual hours against the estimate in iteration [1].

Story	Task	Who	Pair Estimate (hrs)	Actual (hrs)
Everyone should be able to learn more about the clinic. (Story Points1: 1)	Home page (tabs: home, services, registration, login, search clinic)	Nusrat, Riaz	8	8
Patient Registration Nurse Registration Doctor Registration (story points: 1)	Registration form (Patient, Doctor, Nurse) + debug	Venkata, Chandrika	8	12 (Not Completed)
Login for everyone (Story Points: 1)	Login page + debug	Supriya, Gargi	8	10 (Not completed)
Clinic Information (Story Point: 1)	Search clinic page [filter: area, name]	Ashish, Gargi	8	0 (unable to start)
	Acceptance test	Frederick	8	4 (Not completed)
Users collection (story points: 1)	New: Code / implement user model [new task added]	Ashish	6	8
Login for everyone (Story Points: 1)	Generic Landing page [user home page]	Nusrat, Riaz	8	5

Patient Registration (Story Points: 1)	Patient's History page (Social history, Medical history page, Family history)	Venkata, Chandrika	8	0 [Not started]
Patient View and update appointment (Story Points: 1)	Appointments Page(patient's view)	Supriya, Gargi	8	0 [Not started]
View patient records (Story Points: 3)	View EMR reports	Ashish, Gargi	8	0 [Not started]

Table 9: Measuring the actual hours against the estimate in iteration [2].

Story	Task	Who	Pair Estimate (hrs)	Actual (hrs)
Patient Registration Nurse Registration Doctor Registration (story points: 1)	Backlog: Registration form(Patient, Doctor, Nurse) - debug only	Venkata, Chandrika	2	2
Login for everyone (Story Points: 1)	Backlog: Login page - debug only	Supriya, Gargi	2	2
Clinic Information (Story Point: 1)	Backlog: Search clinic page [filter: area, name]	Ashish, Gargi	8	8
Patient records (Story Point: 1)	New: Model for Patient's record [new task added]	Fredrick	4	4 [Completed]
	Backlog: Acceptance test	Frederick	8	4

				[Completed]
Patient Registration Nurse Registration Doctor Registration (story points: 1)	Patient's Profile page (Social history, Medical history page, Family history)	Venkata, Chandrika	8	0 [Not implemented] Will be taken for Release 2.0
Patient's View and update appointment (Story Point: 1)	Appointments Page(patient's view)	Supriya, Gargi	8	0 [Not implemented] Will be taken for Release 2.0
View patient records (Story Points: 1)	Nurse dashboard/landing page	Nusrat, Riaz	12	8
Search patient records for doctor and nurse. (Story Point: 2)	Search Patient records (Nurse/doctors view)	Venkata, Chandrika	12	0 [Not implemented] Will be taken for Release 2.0
View patient records (Story Points: 1)	Patient landing page	Supriya, Gargi	12	8
View patient records (Story Points: 1)	Doctor's landing page	Ashish, Gargi	8	8
Add / update patient data (Story Points: 1)	Preliminary examination page (Nurse View)	Frederick	8	8
Add notes on check up for a particular patient (Story	Doctor's physical examination page	Chandrika, Supriya	12	8

Points: 1)				
Book and view appointments (Story points: 3)	Appointment Page(Nurse's view)	Chandrika, Supriya	12	0 [Not implemented] Will be taken for Release 2.0
A doctor is able to select a patient and refer them for lab work.	Select Patient from dropdown and refer to lab work	Chandrika	8	4 [Partially implemented]

2.4.5 Additional Documentation

We converted user stories into tasks for iteration 1 and 2 execution. team members collaborated on google drive to identify the tasks for each story and once the tasks were identified, we all voluntarily chose tasks based upon our interest. Our team decided to use pair programming technique during task assignment exercise. Hence two team member names are reflected under the 'Who' column in table 1 and 2. The 'Actual' time taken column will be updated after completion of the tasks.

Below is the link for the recorded video session of the meeting.

Recorded Meeting link:
https://drive.google.com/file/d/1XaiT0NWYtzjG8cqS8CTCifjrwXeEjFOu/view?usp=sharing

2.4.7 Acceptance Tests for Release 1.0

Stories, acceptance tests, and contributors for Release 1.0 (Green=Passed; Red=Failed).

Table 10: Acceptance tests for stories chosen for iteration [1].

Full description of user story	Acceptance criteria/test(s)	Name(s) of contributing Developer(s)
All users can view the information about the clinic and its contact information.	**Test:** Click on home link to view contents related to home page **Expected outcome:** Home page contents are displayed **Test:** Click on Services link to view contents related to services **Expected Outcome:** Services Page contents are displayed **Test:** Click on the Search Clinic link to view the search clinic page. Select country and city from the combobox. Click the Submit button to view the clinics. **Expected outcome:** When we choose Canada and Scarborough, all the clinics in Scarborough are displayed.	Nusrat, Riaz, Ashish and Gargi.
As a user I should be able to access EMR system	**Test:** Go to the registration page, enter the respective details, select the profile (r patient, doctor or the	Registration: Venkata, Chandrika,

	nurse) and click on the Register button. • Nurse registration • Patient Registration • Doctor registration **Expected outcome:** logins to the respective landing page after registration. **Test:** Login **Expected outcome:** A registered user should be able to login to their respective landing page and be able to logout.	Supriya, Gargi. Landing pages: Nusrat, Riaz, Ashish, Gargi
As a patient I can see my physical examination history.	**Test** : When the patient logs in, he/she should be able to see the list of clinical visit records containing physical examination history. **Expected outcome**: the patient should be able to view the previous medical (physical examination) history with doctor notes with prescriptions if any.	Supriya, Gargi, Chandrika, Fredrick
A doctor can select the patient who is due next in the queue for a checkup.	Test : After the doctor is in the add patient details page, click on the combo box to select the patient. Expected outcome: After the doctor is in the add patient details page, click on the combo box to select the patient. The patients listed in it should have an appointment on that particular day.	Chandrika
As a doctor,, I should be able to access the	**Test**: After Doctor is logged in, he should be able to select	Chandrika, Supriya, Fredrick

EMR system to **add** and **update** patient EMR data (preliminary physical examination data and notes plus any prescription)	the particular patient and enter the information in the text field provided in the form and be able to click on the submit button. **Expected outcome**: The new record is added to the records table in the doctor home page. **Test**: The Doctor should be able to view and update the existing patient record with the preliminary examination details of the particular patient. Doctor selects that record by clicking on the update button to update the physical examination results. The doctor should be able to update the notes in the form and click on the update button. **Expected Outcome**: The existing record is updated in the list of records on the doctor's landing page.	
As a nurse, I should be able to access the EMR system to **add** and **update** patient data and preliminary physical examination data.	**Test**: After the Nurse is logged into the EMR system, she can add a new physical examination record for a patient. The nurse should be able to select the particular patient and enter the preliminary examination details in the form and be able to click on the Add button. **Expected outcome**: A new record is added to a patient's physical examination history. **Test**: After Login, Nurse should be able to select an existing EMR record to edit by clicking an update button which leads to a new edit page where the	Nusrat, Riaz, Supriya, Gargi, Fredrick

	nurse can edit the details and submit. **Expected outcome**: The changed details are reflected in the records table on the medical history page.	

Link to youtube Demo Video for EMR:

https comp231 sec004 team1 emr herokuapp com Demonstration - YouTube

3.0 CONCLUSIONS

EMR (Electronic Medical Records) solution that has been created in this project is a web app which has been built using tools Express.js, Node.js, npm, passport, and hosting services such as Mongodb Atlas and heroku, and Github which is used for version control. Below are links to github and the hosted URL for EMR.

GitHub: https://github.com/codingcarvers/W2021-COMP231-Sec004-Team1
URL for EMR: https://comp231-sec004-team1-emr.herokuapp.com/

EMR (Electronic Medical Records) system is usually a complex application. For our project, we selected the basic functionality. Three types of users, i.e. patient, doctor and nurse can use this system. It allows users to add, update and view the patient records. We planned to incorporate the appointments feature too but, due to the database connectivity issues, we had to move it to release 2.0.

There was no major issue within the team. Team members coordinated well on MS Teams and Google Drive. Every team member tried to contribute. Only minor issues were due to some time constraints. That is why some of the team members were not always available. There was a very good team spirit.
Due to database connectivity issues, some of precious time was lost causing a pile up of some backlog.

4.0 RECOMMENDATIONS

The release 2.0 would include the appointments and security features by safe registration in the EMR web app. We also recommend including tools for the patients to track their data such as Vaccination Records, Prescriptions, Family History, Treatments, Specialist Recommendations and reference tools. We would also like to extend the services to purchase the medications through this app and the prescription is shipped to the particular patient.

In Future, EMR can potentially move forward to NG-EMR (Next Generation - Electronic Medical Records) which will implement Augmented Reality for diagnosis and Artificial Intelligence to Help the Doctors and Nurse to save time on documentation. These features would be the perfect solution at the time of pandemic such as the one we are now facing the COVID - 19.

5.0 CREDITS, LICENSE, AND REFERENCES

5.1 Credits

Provide any credits here. The following are examples:

Author of the template graphic layout : Hao Lac <haolac.at.centennial@gmail.com>

Author of the template explanation text : John Doe <john.doe@centennialcollege.ca>

Project Sponsor: Bob Pajkowski <bpajkows@my.centennialcollege.ca>

EMR Project Team Members:

5.2 License

5.3 References

[1] Cohn, Mike. 2004. *User Stories Applied: For Agile Software Development*, Addison-Wesley Professional.

APPENDIX A (DESIGN DOCUMENT)

Use Case Diagram:

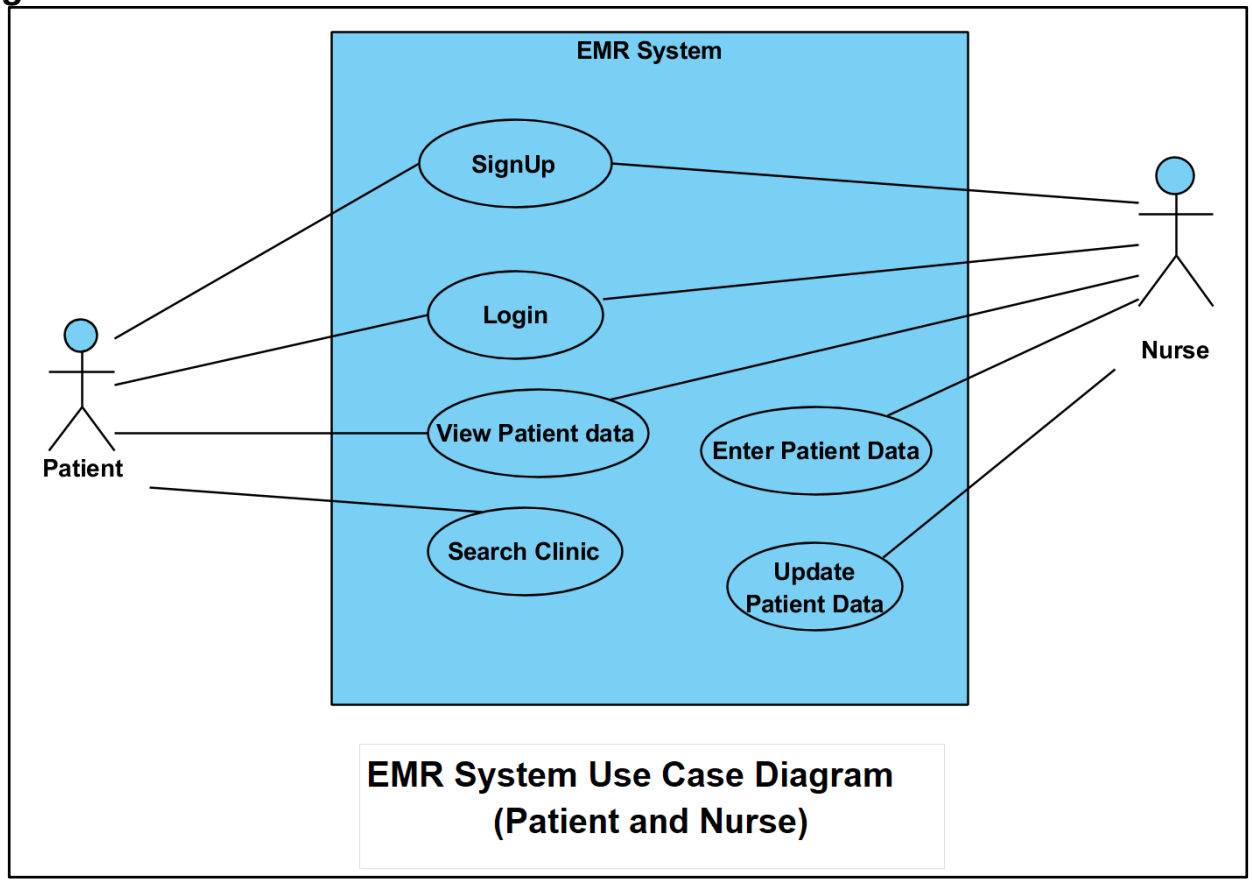


Figure 5: Patient and Nurse Use Case Diagram

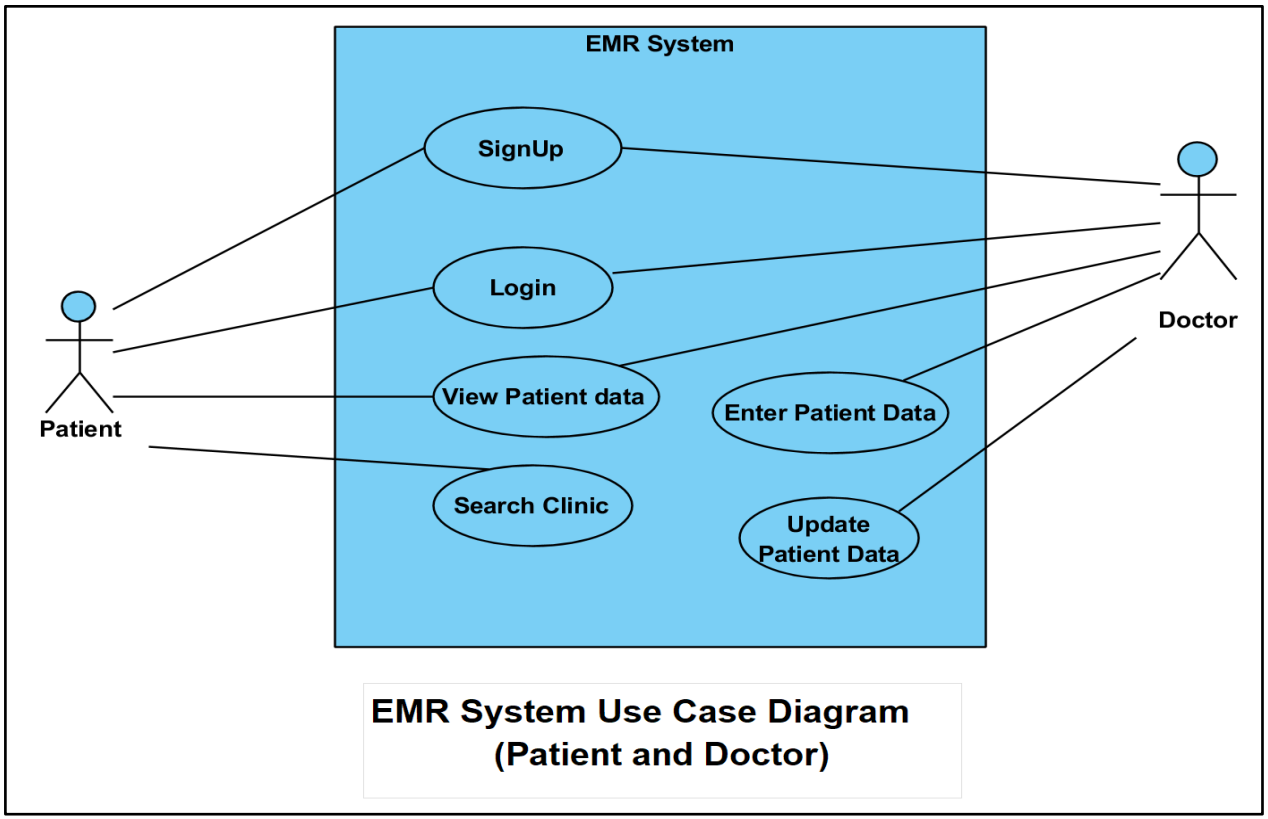


Figure 6: Patient and Doctor System Use Case Diagram

Activity Diagram:

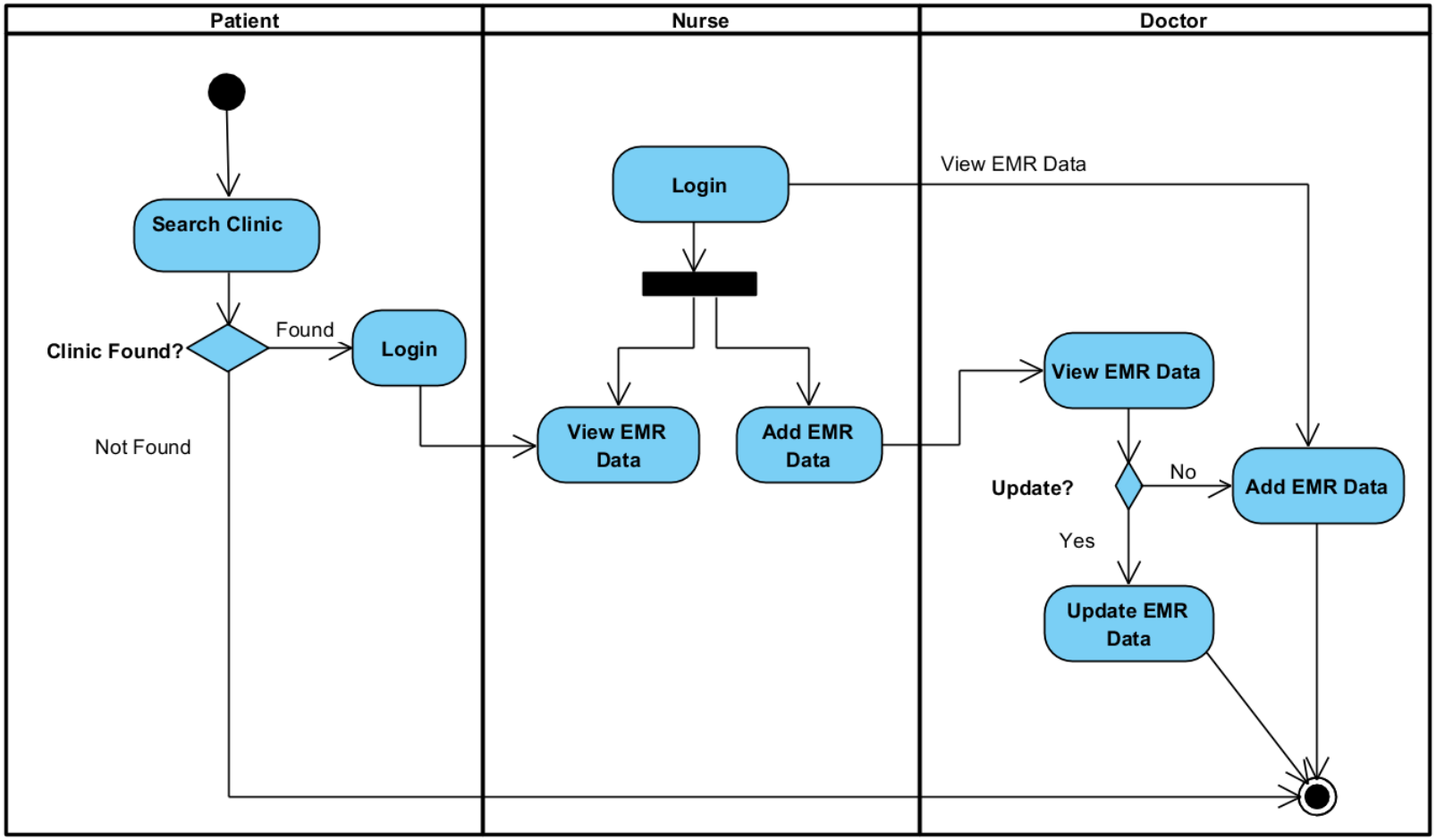


Figure 7: Activity Diagram using swimlanes

Package Diagram:

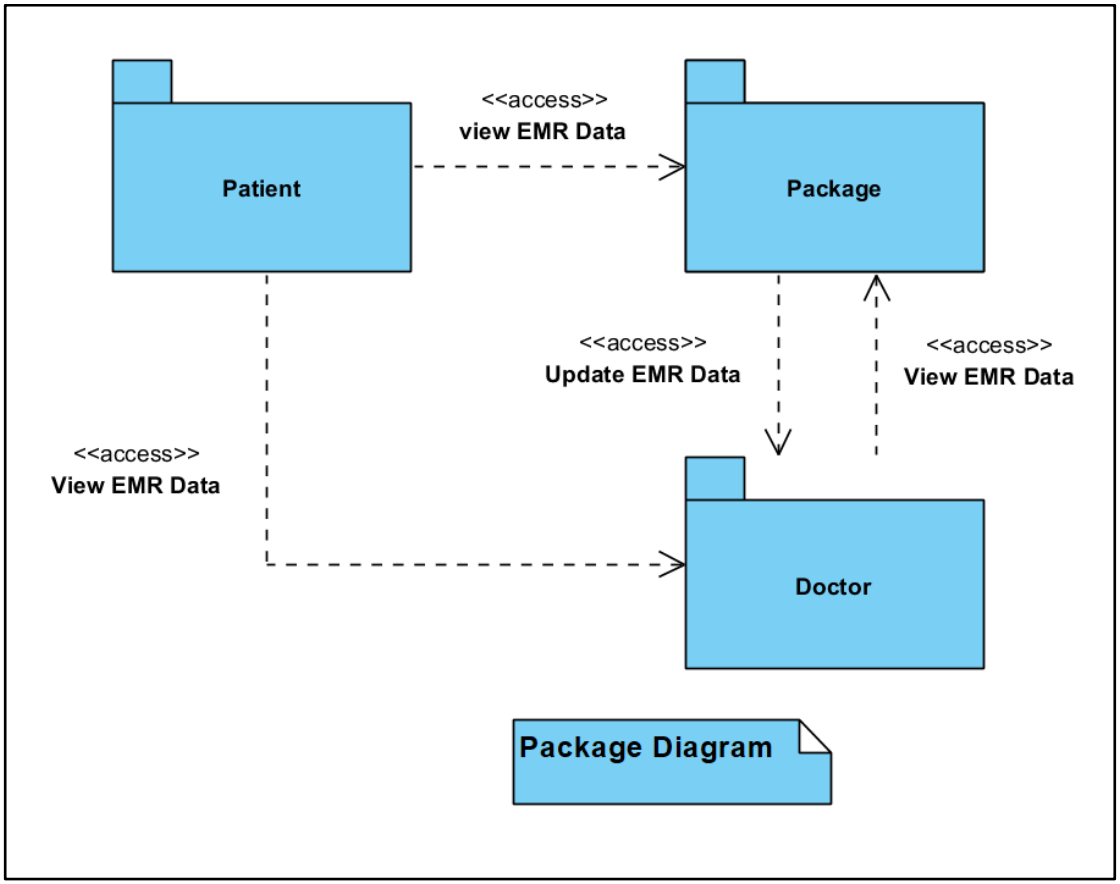


Figure 8: Package Diagram

Deployment Diagram:

Deployment diagram is a diagram that shows the configuration of run time processing nodes and the components that live on them. Deployment diagrams is a kind of structure diagram used in modeling the physical aspects of an object-oriented system. They can often be used to model the static deployment view of a system (topology of the hardware).

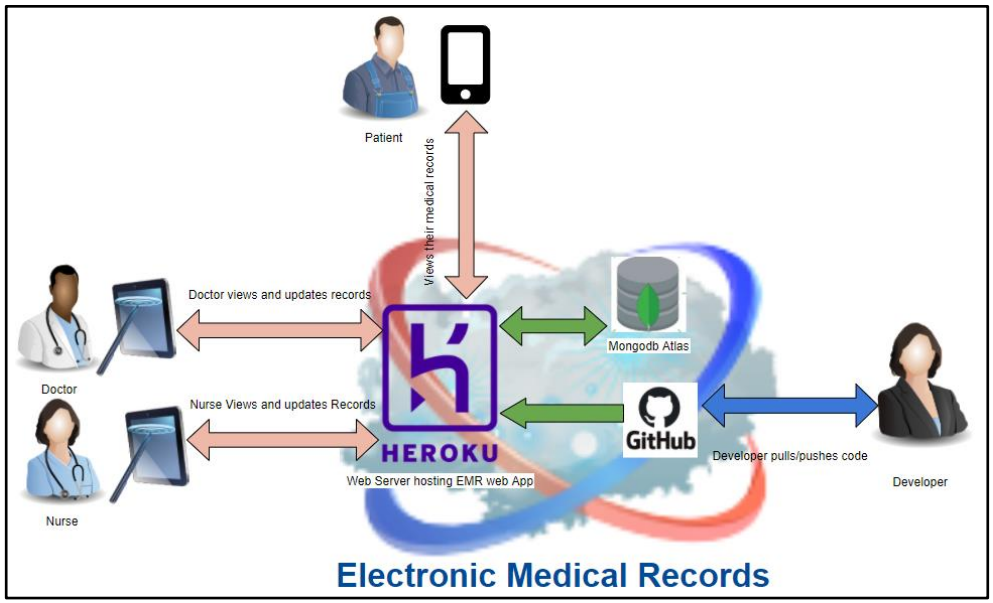


Figure 9: Deployment Diagram

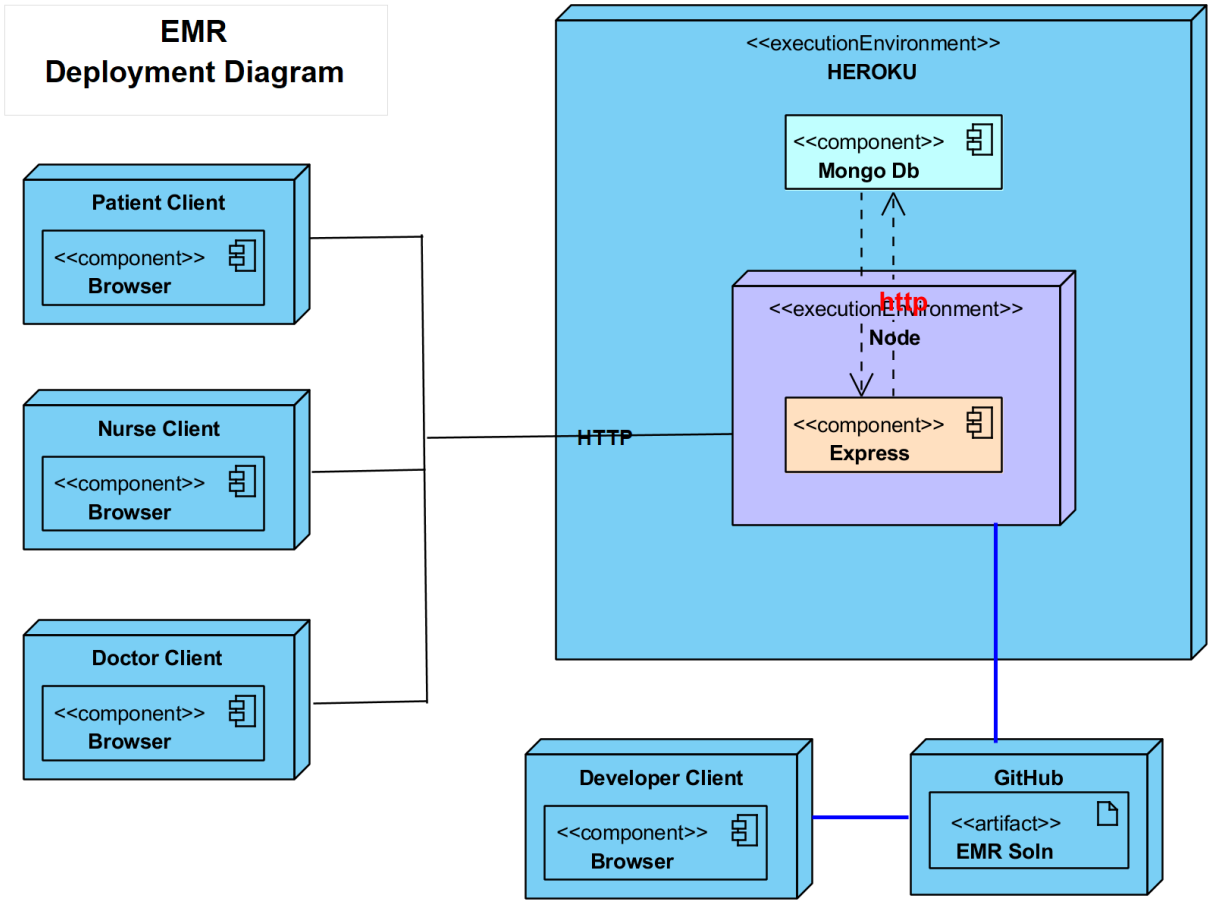


Figure 10: Deployment Diagram

Architecture Diagram:

The architecture of our application is based on a typical MVC model. Our Client tier (View) will be written in Javascript, HTML, and CSS, using ExpressJS as the framework. This level of the architecture is what the user will interact with to access the features of our application.

The Business Logic Tier (Controller) will be written using NodeJs and ExpressJS, and this tier represents the Application Server that will act as a bridge of communication for the Client Tier and Database Tier. This tier will serve HTML pages to the user's device and accept HTTP requests from the user and follow with the appropriate response. Our Database Tier (Model) will be hosting MongoDB. This is where we will store all of the crucial data our application needs to function.

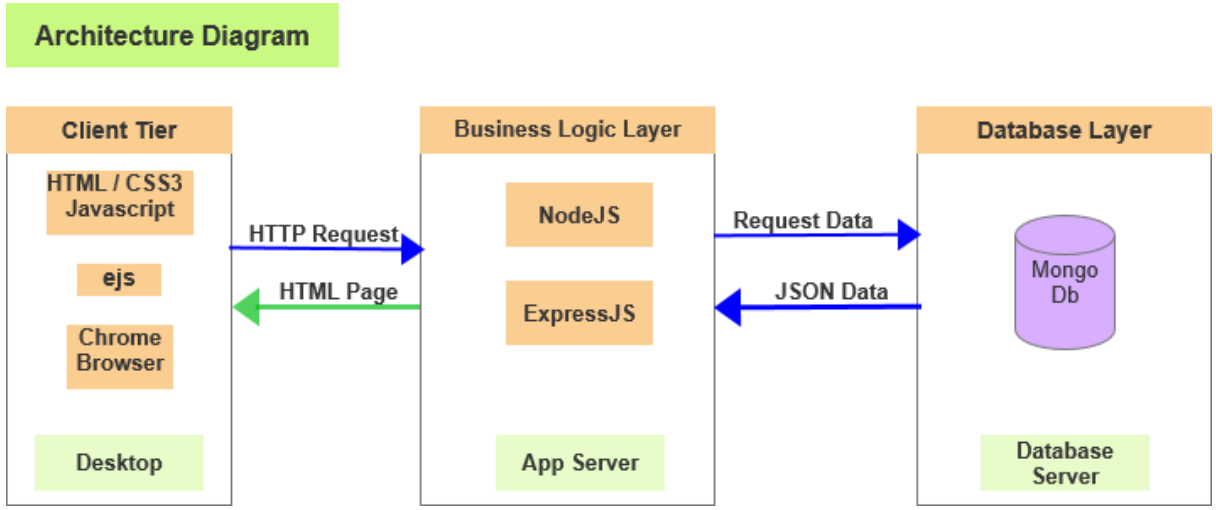


Figure 11: Architecture Diagram

Component Diagram:

Component diagrams are essentially class diagrams that focus on a system's components that are often used to model the static implementation view of a system.

Since we have used Express Stack (Mongo Db, Express, Node JS) with functional programming, there will be no component diagram for our project.

Class Diagram:

There is no class diagram for our application. We have used Node JS Express Emerging Technology platform. It uses functional programming techniques. It has parted away from Class to Functional Programming concepts. Our Model consists of only JS models: User and PreliminaryExam. Three types of users (Patient, Nurse, Doctor) can be implemented by using only one model, which is again not a class. It is a JavaScript function only. Emerging technologies have shifted away from classical class model to functional model concepts. Class concepts are common for programming languages such as C#, Java, and even Python.

Object Diagram:

There is no object diagram for our application. We have used Express Node JS platform with functional programming.

ERD:

We have used MongoDB as a database, which is a NoSQL database. So there is no concept of ERD for such a database. Even then we included an ERD which closely resembles a classical ERD.

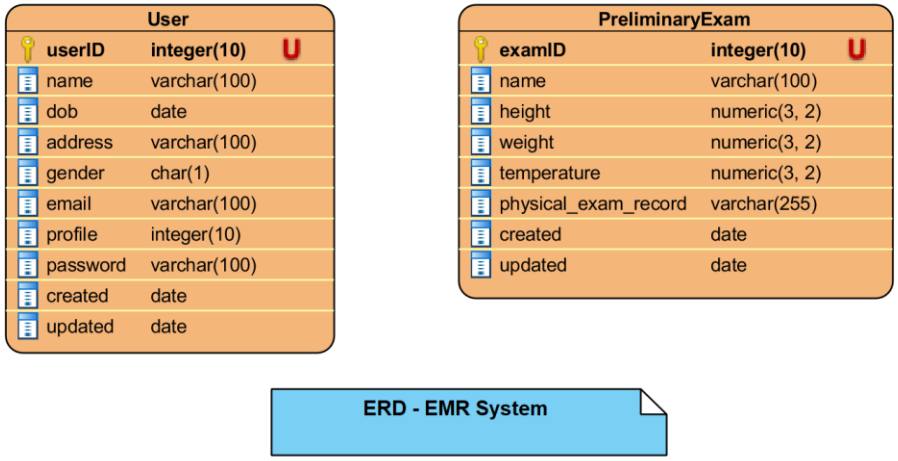


Figure 12: Entity Relationship Diagram for Release 1.0

Sequence Diagrams:

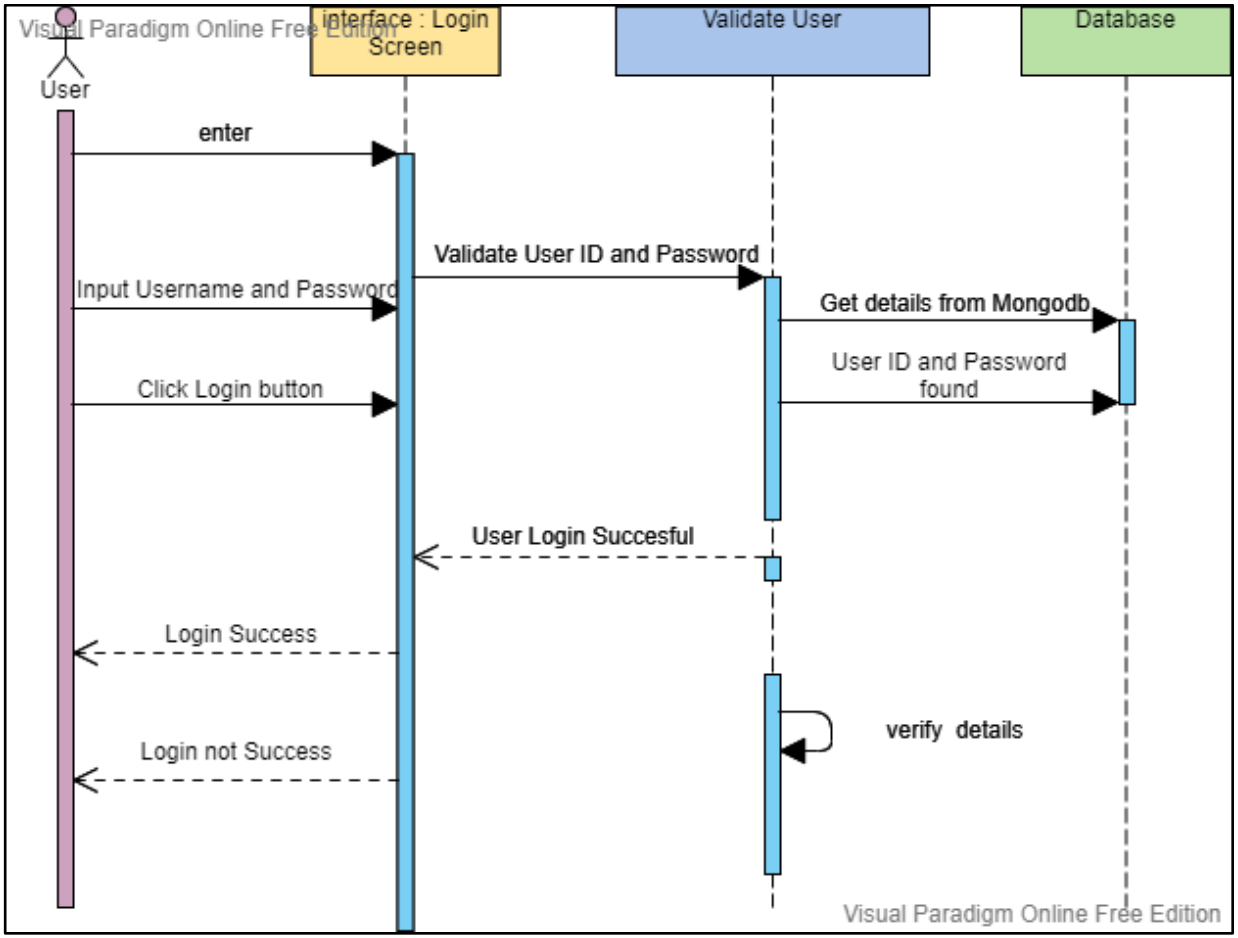


Figure 13: User Login Sequence diagram

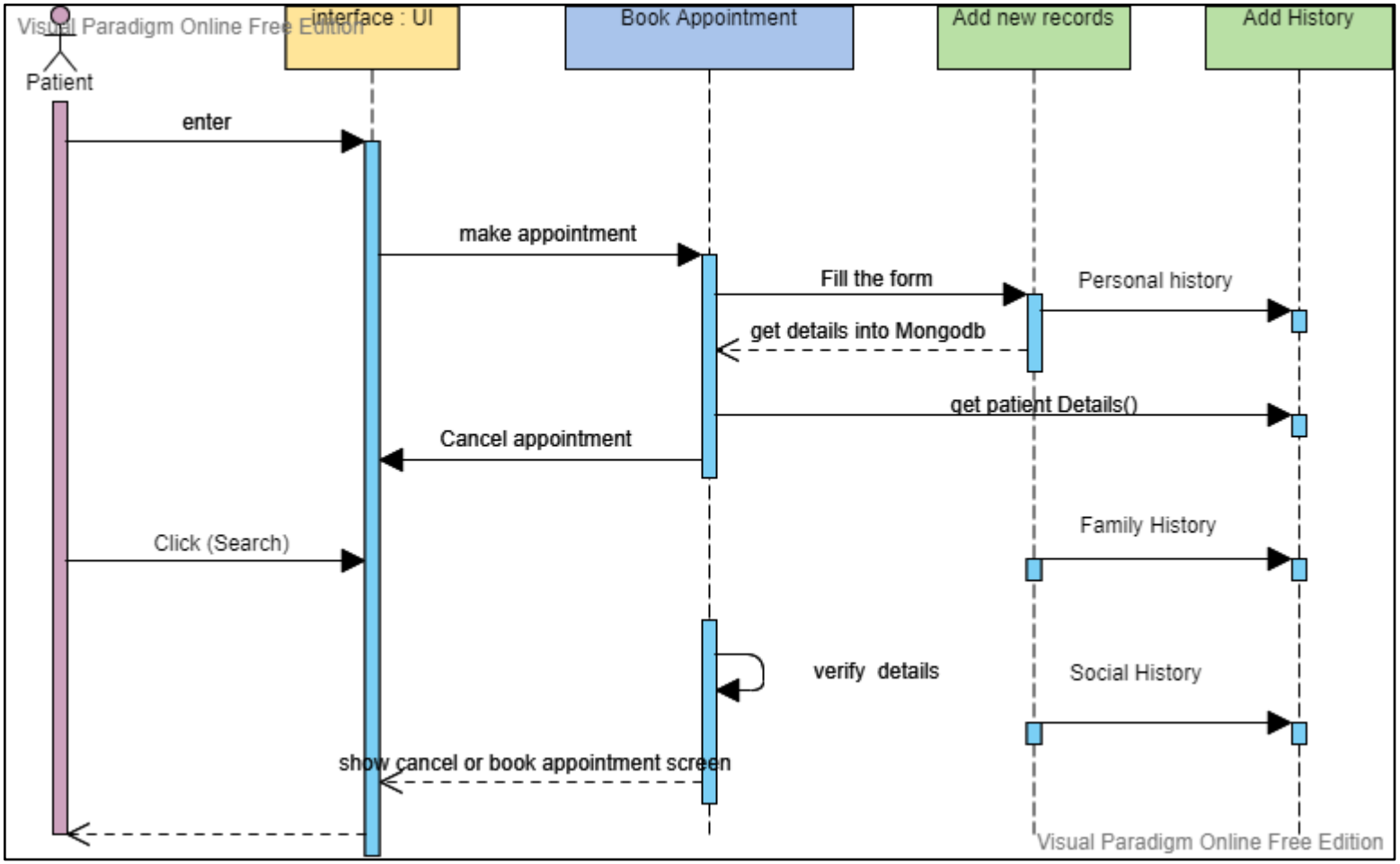


Figure 14: Patient Appointment Booking Sequence diagram

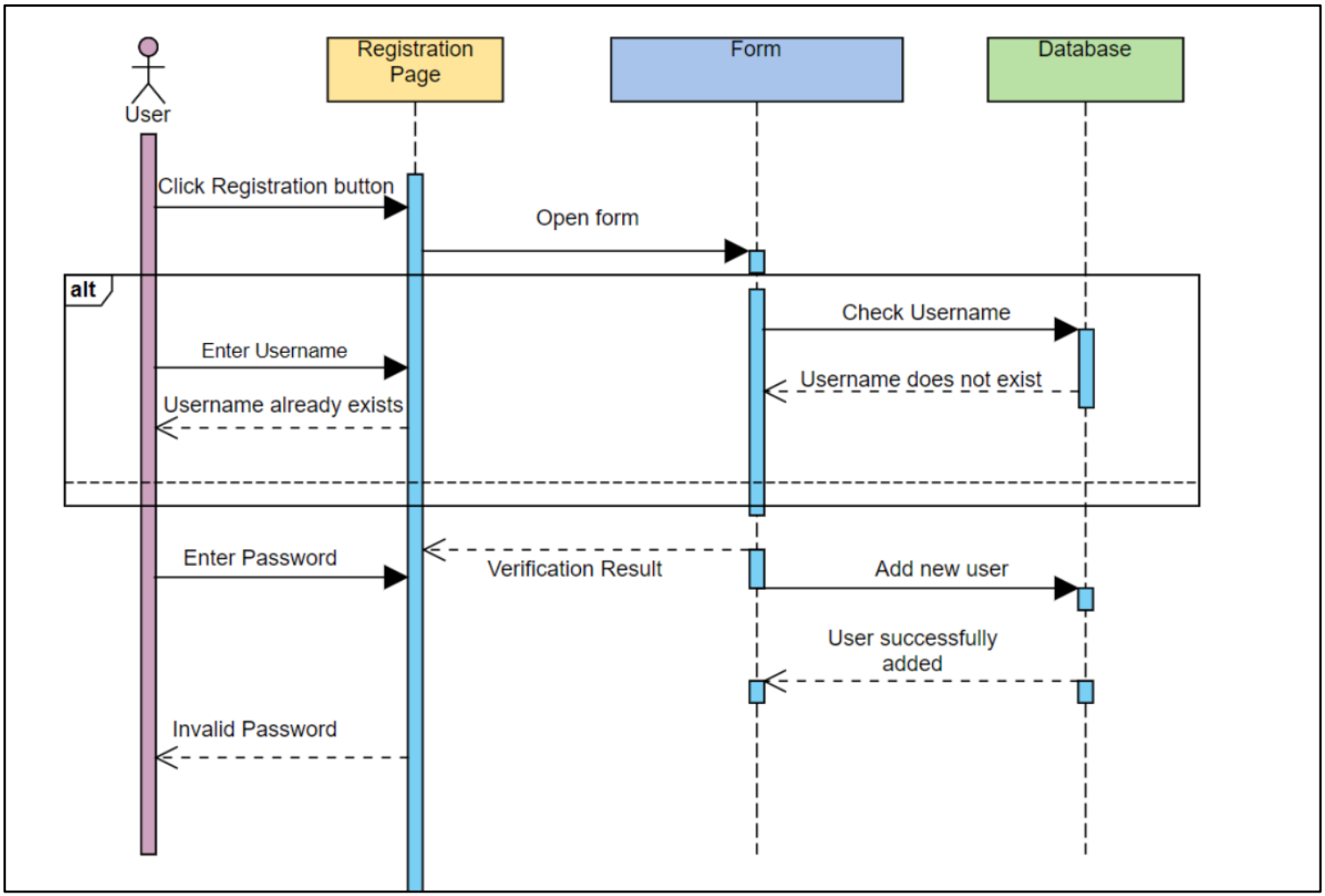

User
Registration Page
Form
Database
Click Registration button
Open form
alt
Check Username
Enter Username
Username does not exist
Username already exists
Enter Password
Verification Result
Add new user
User successfully added
Invalid Password

Figure 15: User Registration Sequence diagram

PAPER PROTOTYPE (the UI)

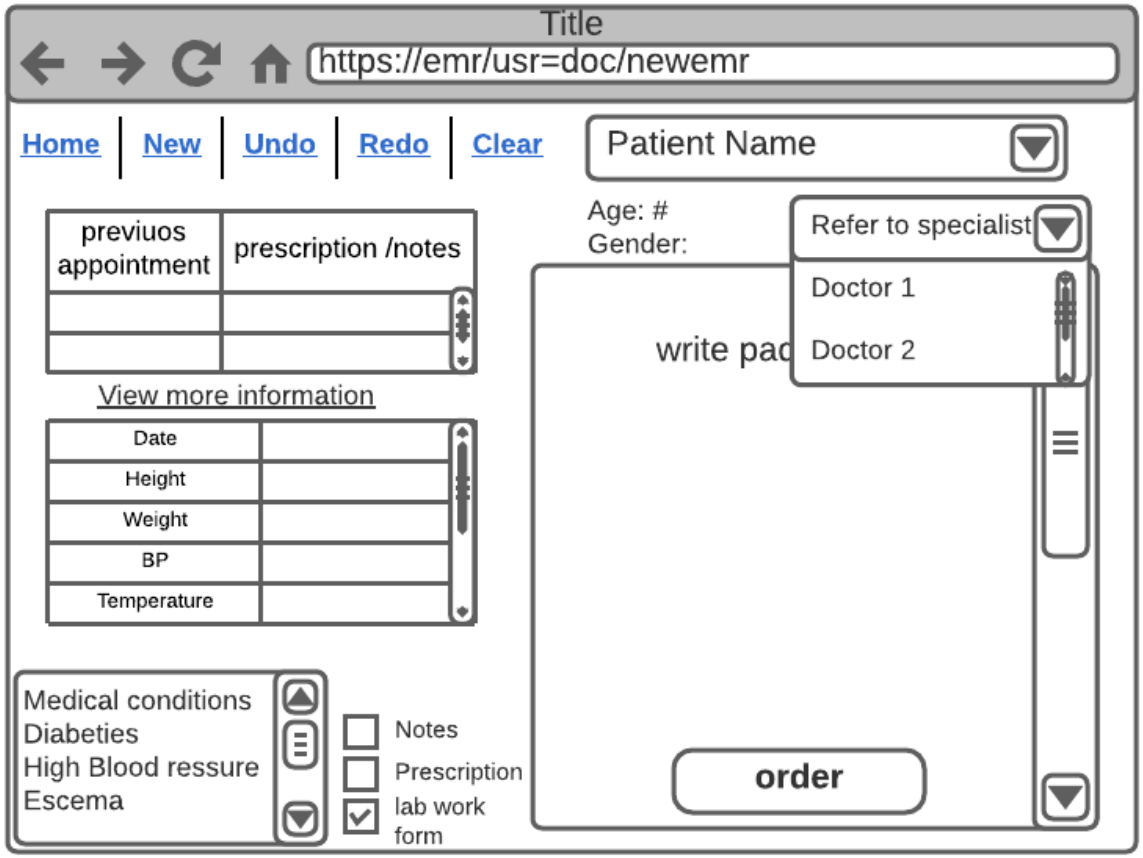


Figure 16: Wireframe for Doctors Physical examination/New EMR page showing space to add notes/ prescription.

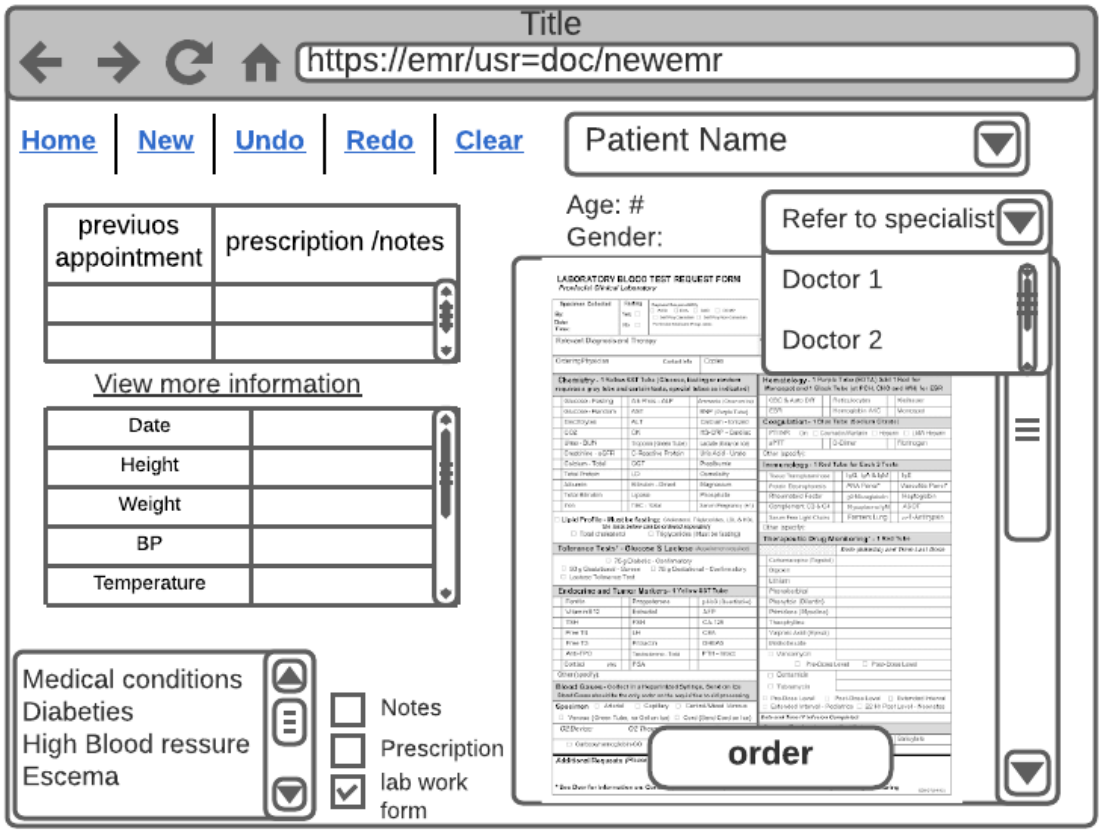
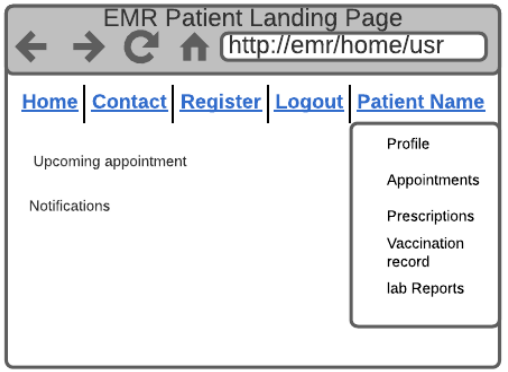
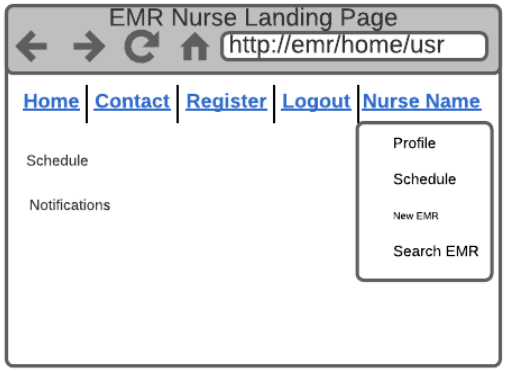
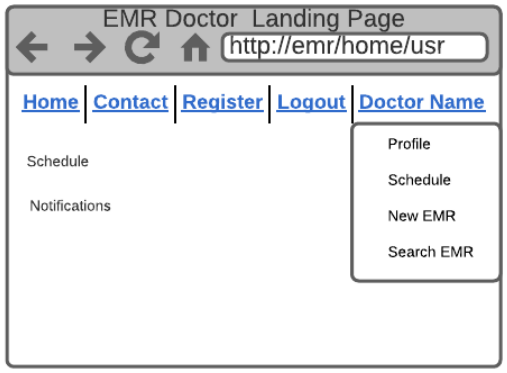
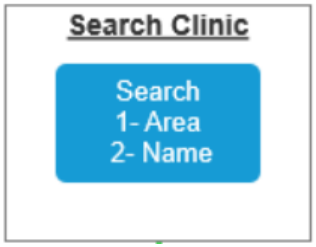
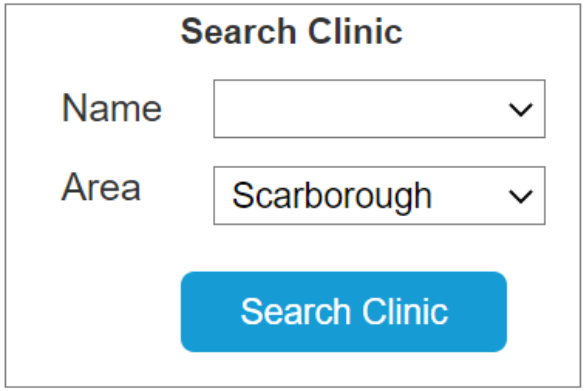


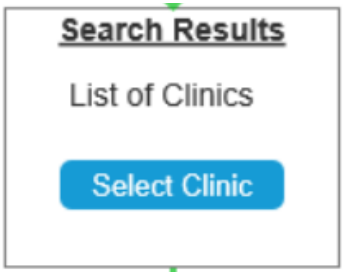
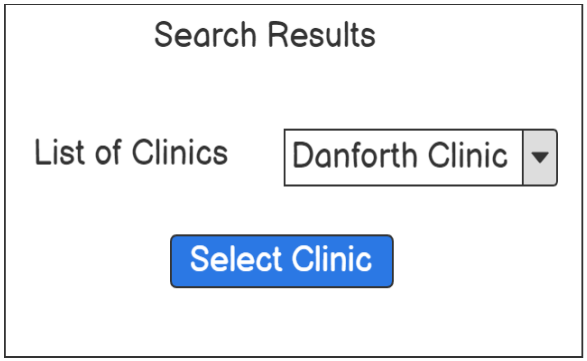
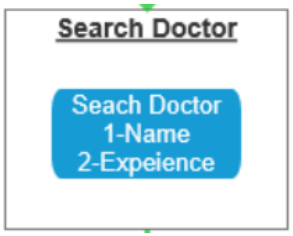
Figure 17: Wireframe for Doctors Physical examination /New EMR page showing lab work order

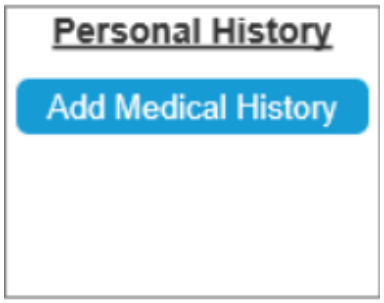
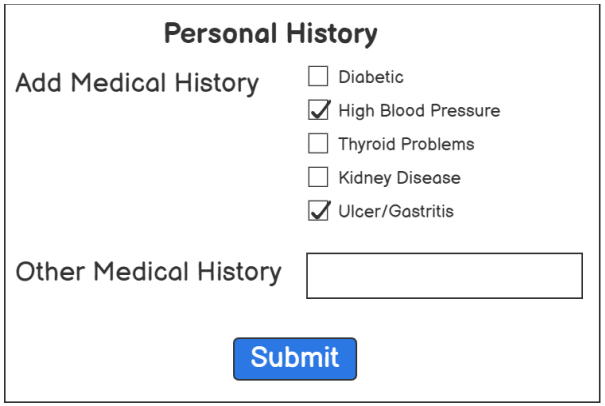
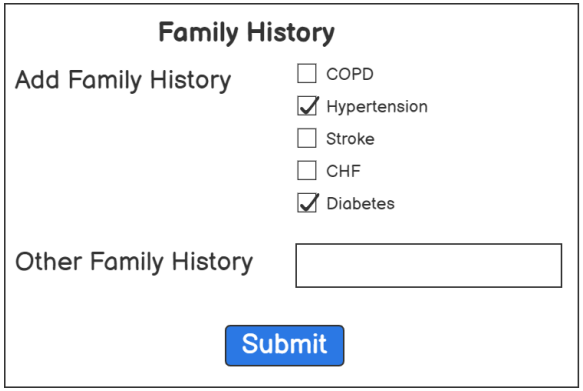
Table 11: Displaying Wireframes and the revised stories

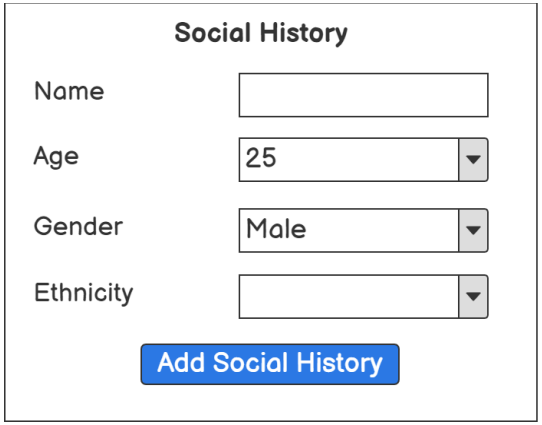
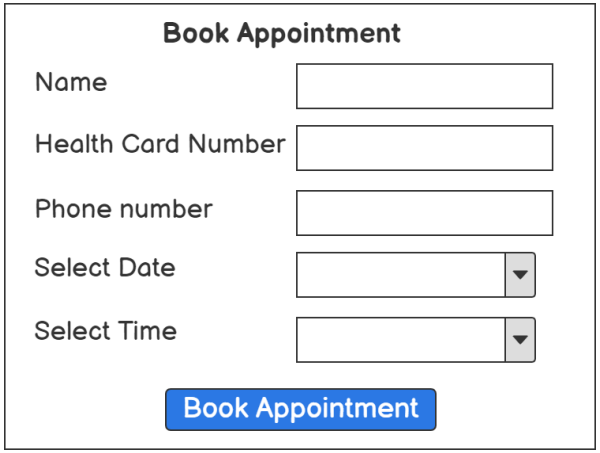
User Role	Low Fidelity Prototype Box	Wireframe	Revised User Story
Patient Doctor Nurse		Before login: Home page, Registration page, contact/search page.  After Login: Home page, contact/search page, Dashboard (Profile info, appointment info, Medical History)	I as a user should be able to see EMR system information and services. As a Patient, I should be able to see my dashboard with my details when I login. As a Doctor, I should be able to see my dashboard with my details when I login As a Nurse, I should be able to see my dashboard with my details when I login

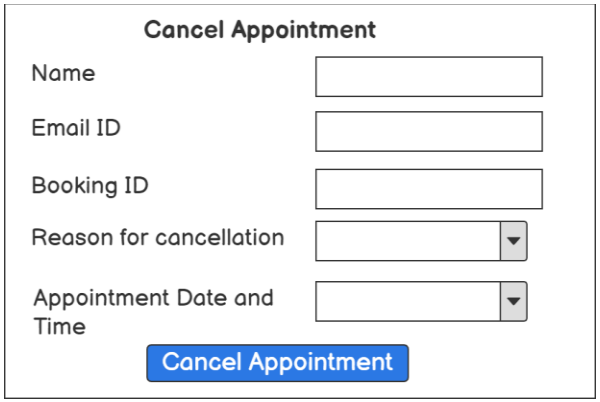
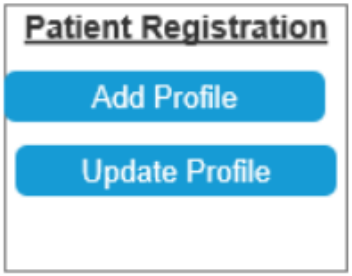
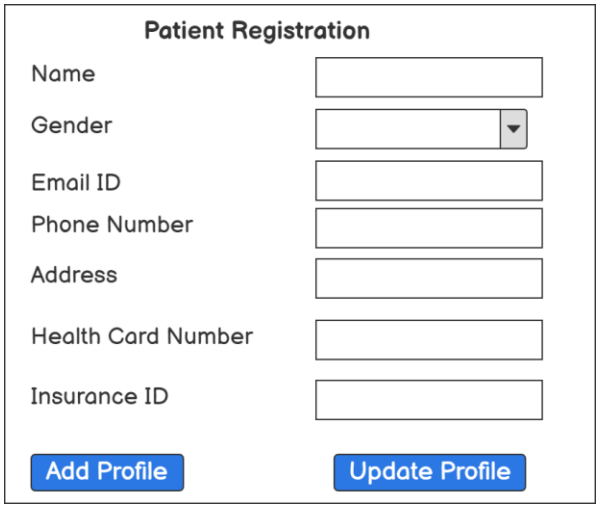
		 EMR Patient Landing Page http://emr/home/usr Home Contact Register Logout Patient Name Upcoming appointment Notifications Profile Appointments Prescriptions Vaccination record lab Reports  EMR Nurse Landing Page http://emr/home/usr Home Contact Register Logout Nurse Name Schedule Notifications Profile Schedule New EMR Search EMR	

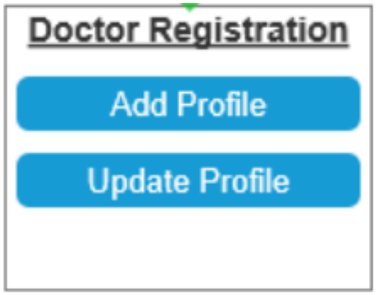
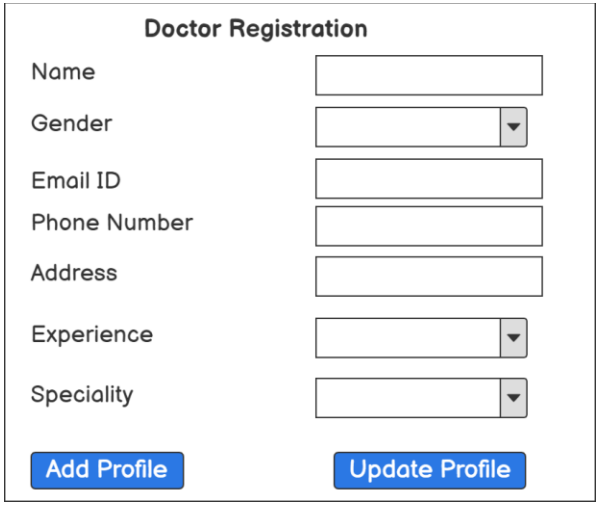
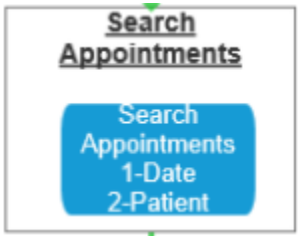
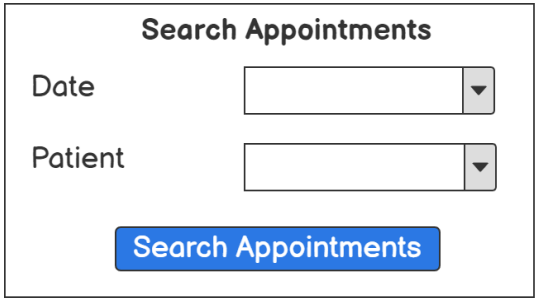
			
Patient			A patient can perform search to find a list of clinics by using Area search field or Clinic name

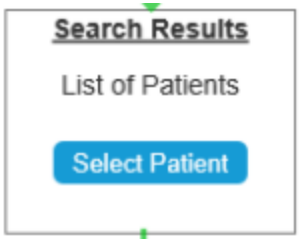
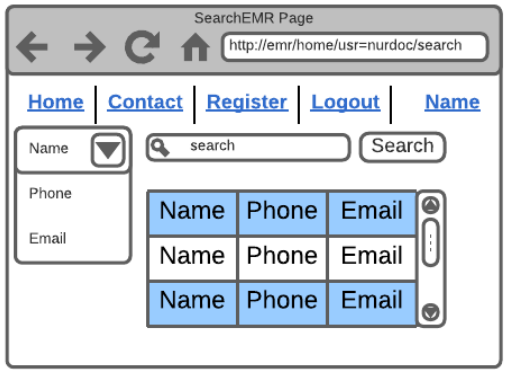
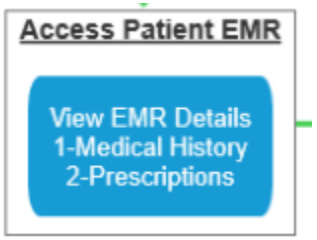
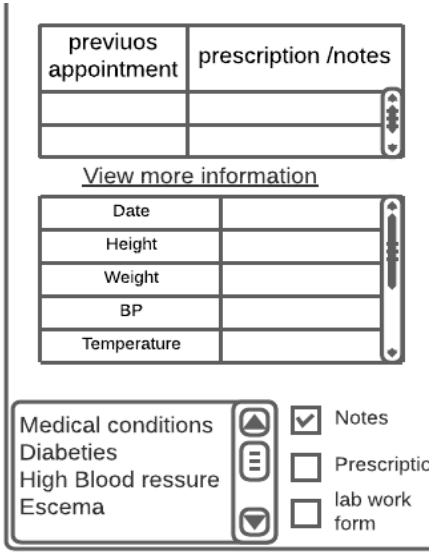
Patient			A patient can also perform search or sorting out the clinics by the list of all available clinics.
Patient			A patient can search any doctor working for the clinic by his/her name and specialization of the doctor

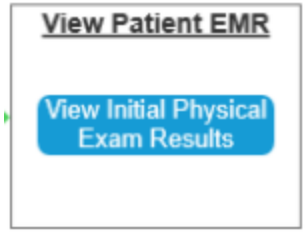
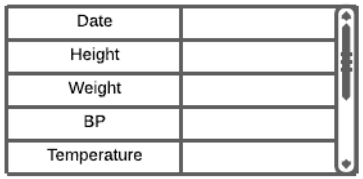
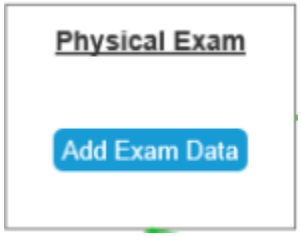
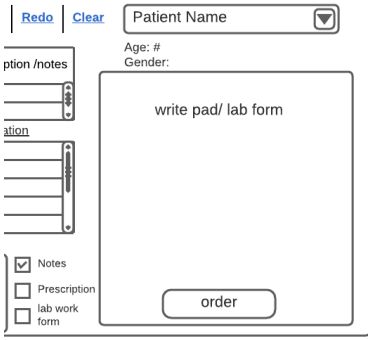
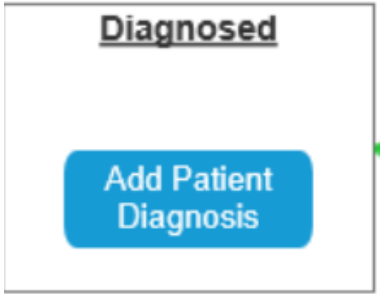
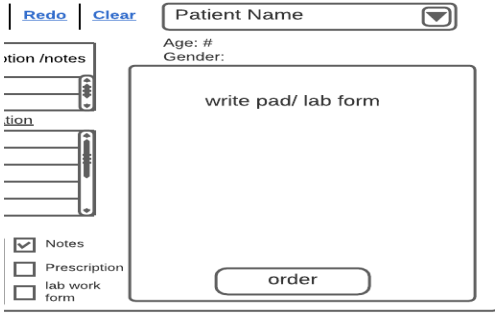
Patient			A patient should provide his personal medical history details like Diabetes or Blood pressure or thyroid problems or kidney diseases, ulcer/gastritis etc. He can also specify any other medical problems in the next column
Patient			A patient should provide his Family's history of medical issues like Diabetes , Blood pressure, COPD, Hypertension, Stroke, CHF etc. He can also specify any other family's medical problems in the next column.

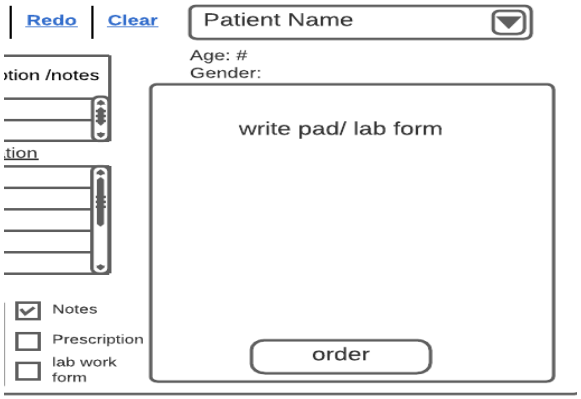
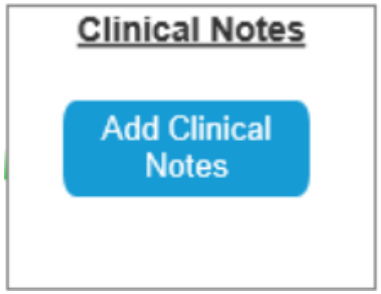
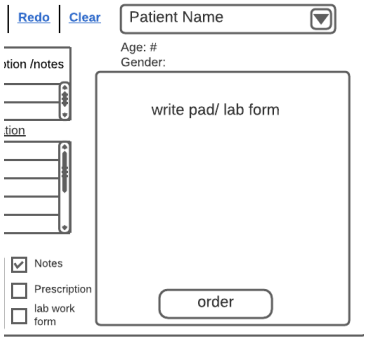
Patient			A patient should fill his social details like name, age, gender and ethnicity in order to have a better idea of the patient and his need for the clinic.
Patient			A patient should be able to book the appointment by entering his basic details like Name, health card number and Phone number. The patient should also specify the date and time in order to book his appointment.

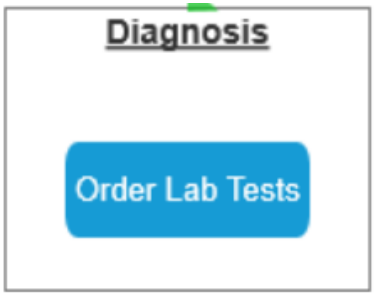
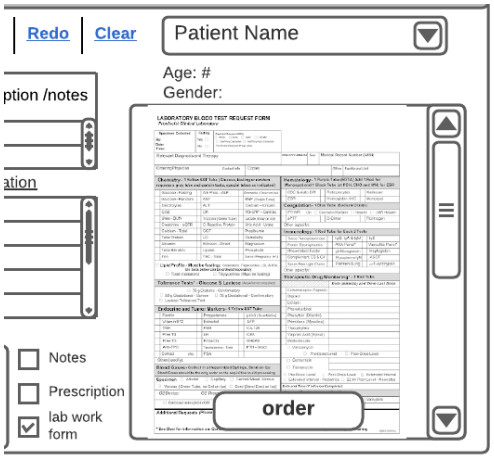
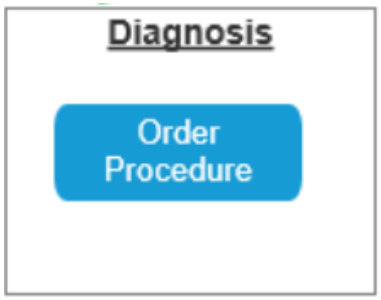
Patient			A patient should be able to cancel the appointment by entering his basic details like Name, Email id, and Phone number. A patient should specify the reason for cancelling the appointment and he also needs to enter the appointment details like date and time in order to complete his cancellation of any appointment.
Patient			A patient should be able to register to the clinic by entering his basic details like Name, Gender, Email id, Phone number, Address, Health card number and insurance Id. A patient can add something to his profile later or can update his profile details anytime using add and update buttons.

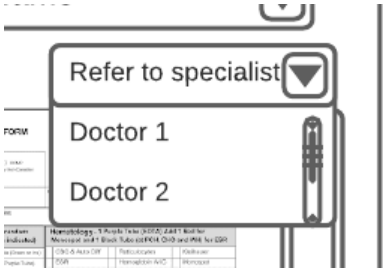
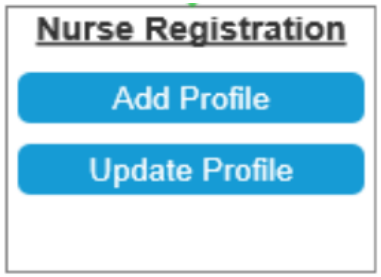
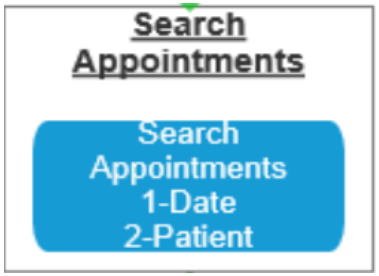
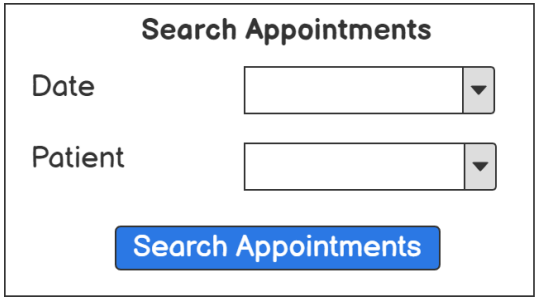
Doctor			A Doctor should be able to register to the clinic by entering his basic details like Name, Gender, Email id, Phone number, Address, Experience(in years) andSpeciality. A Doctor can add something to his profile later or can update his profile details anytime using add and update buttons.
Doctor			A doctor should be able to search or sort out all his appointments, either by date or by patient name

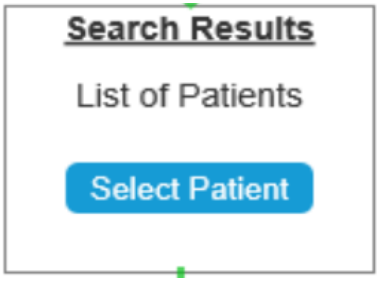
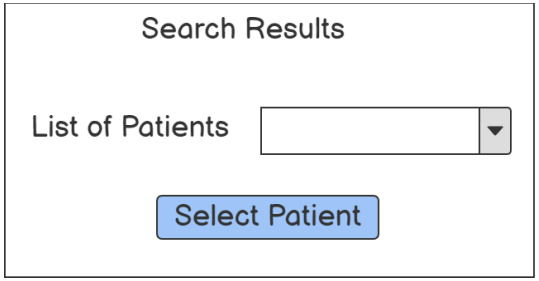
Doctor/ Nurse			As a Doctor/Nurse I should be able to search for patients in the records, so that I can click on their record to view their details.
Doctor			I, as a Doctor, should be able to view the latest history of the patient, when a patient is selected for a physical examination.

Doctor			As a Doctor, I should be able to view the initial physical examination made by the Nurse.
Doctor			As a Doctor, I should be able to make a note of the physical examination data by clicking order.
Doctor			As a Doctor, I should be able to make a note of the physical examination data/diagnosis.

Doctor			As a Doctor, I should be able to make a note of the physical examination data/diagnosis.
Doctor			As a Doctor, I should be able to make a note of the physical examination data/diagnosis.

Doctor			As a Doctor, I should be able to order a lab test for the patient.
Doctor			

Doctor			As a Doctor, I should be able to refer the patient for the reason he is on the day to a specialist. Note: Reason to be on the notes.
			
Nurse			As a Nurse, I should be to search all the booked appointments by date or patient name.

Nurse			As a Nurse, I should be able to search patient's name so that I can view the details of the patient.

APPENDIX B (TEST PLAN)

Introduction

Goals

Key goals for software testing are:

- find bugs and get them fixed
- enhance software
    - quality
    - reliability
    - customer satisfaction
- bug prevention
- reduced maintenance of software

Assumptions

- The solution will be deployed on cloud before start of testing and will be available for testing activity
- There will be no code updates during testing
- Developers will be responsible for big fixing and code upload to cloud
- Regression testing will be done after bugs are fixed

Risks And Assets

Risks

- Software development delays will reduce the time available for testing
- Exhaustive testing cannot be performed. Only selected test cases will be executed
- If enough time is not allocated to software testing and bug fixing, some

bugs may not be identified. They may be identified, lated, by customer causing loss of credibility and customer confidence

- If time estimates (effort sizing) is not properly, testing coverage may be reduced
- Delays in software development due to any technical issues, such as database integration, will impact software testing by impacting its schedule negatively

Positive Impact Factors

- If requirements (user stories) are documented and effort estimates are correct with subsequent software development in a timely manner, there are chances that testing will start in a timely manner. Also, development of required test cases of good quality has a positive impact on software testing.

Scope

Features To Be Tested

- Search Clinics based upon country and Area
- Registration for the following users :
    - Patient
    - Nurse
    - Doctor
- Login for the following users based on their profile:
    - Patient

    - Nurse
    - Doctor
- Display of correct page after login
- Patient will be able to view the record of his clinic visits with EMR data
- Nurse will be able to:
    - Add a new record for preliminary exam
    - Update an existing EMR record
    - Deleted an existing EMR record
- Nurse will be able to:
    - View an existing EMR record entered by Nurse
    - update an existing EMR record entered by Nurse
    - Delete an existing EMR record entered by Nurse
    - Add a new record for preliminary exam
    - Update an existing EMR record
    - Deleted an existing EMR record

Features Not To Be Tested

Following features cannot not be tested, as they could not be implemented due to delays caused by database integration issues

- Schedule patient visit to clinic.
- Schedule reminders
- Prescriptions for patients
- Lab test orders

Testing Procedures

Software testing for the EMR project will consist of the following cycles / phases:

- Verification: validate the EMR software requirements are properly done. Identification of testing scope, test conditions and test cases are correctly developed.
- Validation: System / Integration testing will be conducted using manual testing. Identified bugs will be communicated to development team who are responsible for proper bug fixing

Test Objectives

- Identify bugs
- Ensure the fixes
- Ensure that final application code is bug free and all the known bugs are fixed

Types Of Testing

Manual Testing

Manual Testing has been used for acceptance test runs. The video of the test run has been recorded and can be viewed by click here.

Unit Testing

Unit testing will be performed by individual developers during testing

Integration Testing

Integration testing will be performed jointly by development and test resources.

Development team will ensure that all the modules are properly integrated and all the identified bugs are fixed. It will involve a combination of whitebox and blackbox test techniques. Test resources will perform integration testing by executing manual test cases.

Acceptance Testing

Acceptance testing will be performed by test team members by executing registration, login and EMR data CRUD functionality scenarios.

Stress Testing

No stress testing will be performed as it is a prototype application without any mission critical implications.

Performance Testing

No performance testing will be performed as it is a prototype application with less than 100 data records.

Testing Tools

Screen recording tool has been used to record the manual test run for the acceptance test listed in Table 11.

Schedule and Deliverables

Table 12: Schedule of Test Tasks

Sl.#	Task	Deliverable Date
1	User Roles	February 1, 2021
2	User Stories	February 21, 2021
3	Release 1.0 Plan	March 7, 2021
4	Iteration Plan	March 14, 2021
5	Progress Monitoring for Release 1.0.	April 11, 2021
6	Release 1.0 (Code+WebApp URL)	April 11, 2021
7	Acceptance Test	April 11, 2021
8	Technical Documentation	April 18, 2021
9	User and Administrators Manual(TAC)	April 18, 2021

Test Reports:

Table 13: Test Deliverables:

Sl.#	Task	Quantity
1	Test cases	6
2	Manual Testing completed for	6
3	test cases passed	5
4	Percentage of passed test case for release 1.0	100%

Sample Test Cases:

Following are sample test cases used for manual software testing during system testing of the application:

Title	**Search Clinic**	**Goal**	**To verify that a user can search clinics in a given area**	
Test Case ID:	TC-1	Precondition:	User has already accessed the web application	
Created By	Riaz Ahmed	Post Condition:	User will be able to perform search of clinics based upon Country and Area	
Executed By	Riaz Ahmed			

Step #	**User Action**	**Expected Outcome**	**Observation**	**Status**
1	User selects Country and City (Country = Canada and City = Scarborough) and click Submit button	System displays displays list of clinics with related information in a tabular format	System displays list of clinics with associated information in a tabular format	Pass
	Test Case Status (Pass / Fail)	Pass	Pass	

Title	User Registration	**Goal**	To verify that a doctor can register his profile as a doctor in the EMR system	
Test Case ID:	TC-2	**Pre Condition:**	Doctor as a User does not exist in the EMR system	
Created By	Riaz Ahmed	**Post Condition:**	Doctor will be able to register himself in the EMR system	
Executed By	Riaz Ahmed			

Step #	**User Action**	**Expected Outcome**	**Observation**	**Status**
1	User clicks Registration link	System displays Registration Page	Registration page is displayed	Pass
2	Doctor enters registration data	System displays registration information	Registration information is	Pass

	and selects a profile (Doctor).		displayed	
3	Doctor clicks Register button	System saves doctor's information in the database and displays Doctor's home page	Doctor's home page is displayed	Pass
	Test Case Status (Pass / Fail)	Pass	Pass	

Title	Patient Login	**Goal**	To verify that a patient can log into the EMR system	
Test Case ID:	TC-3	**Precondition:**	Patient is already registered in the EMR system	**Test Case Status**
Created By	Riaz Ahmed	**Post Condition:**	Patient will be able to login to the system	
Executed By	Riaz Ahmed			

Step #	User Action	Expected Outcome	Observation	Status
1	Patient accesses EMR system in the browser window	System displays Home page with Login link on the header	Login link is displayed	Pass
2	Patient clicks Login link	System displays Login page	Login Page is displayed	Pass
3	Patient enters Name and Password and clicks Login button	System displays Patient Home page	User (Patient) is logged into the system	Pass
	Test Case Status (Pass / Fail)	Pass	Pass	

Title	Patient data added by Nurse	**Goal**	To verify that a Nurse can add vital signs (Preliminary examination data for a patient)	
Test Case ID:	TC-4	**Pre Condition:**	Patient is already registered in the EMR system	
Created By	Nusrat Ara Riaz	**Post Condition:**	EMR data for a patient is added to the system	
Executed By	Nusrat Ara Riaz			

Step #	User Action	Expected Outcome	Observation	Status
1	Nurse Logs into the system	System displays Nurse home page	System displays patient visit data in a table	Pass
2	Nurse clicks on Add button	System displays Preliminary Examination Form	A form to enter patient data is displayed.	Pass
3	Nurse selects a patient, enters data and clicks Add button	System closes form, adds data to database and redisplays EMR table of patient data	System displays newly added patient data	Pass
	Test Case Status (Pass / Fail)	Pass	Pass	

Title	Update Patient Data by the Doctor	**Goal**	To verify that a doctor can update physical examination data for a patient	
Test Case ID:	TC-5	**Pre Condition:**	Patient data is already added by the Nurse for a patient	
Created By	Nusrat Ara Riaz	**Post Condition:**	EMR data for a patient is updated in the EMR system	

Executed By	Nusrat Ara Riaz			
Step #	**User Action**	**Expected Outcome**	**Observation**	**Status**
1	Doctor Logs into the system	System displays Doctor's home page	System displays patient visit data in a table	Pass
2	Doctor selects newly added Patient record and clicks Update button	System displays Preliminary Examination form with additional Physical Examination Record field.	Patient exam details entered by the Nurse are displayed	Pass
3	Doctor views the patient data and enters medical notes in the Examination Record field	System displays the newly added Physical Examination Notes	System displays the newly added Physical Examination Notes	Pass
4	Doctor clicks Update button	System displays update info in patient data table	Updated patient data is displayed	Pass
	Test Case Status (Pass / Fail)	TRUE	Passed	

APPENDIX C (END-USER & ADMINISTRATOR MANUALS)

END-USER MANUAL

Step 1 : open the EMR website with URL: https://comp231-sec004-team1-emr.herokuapp.com

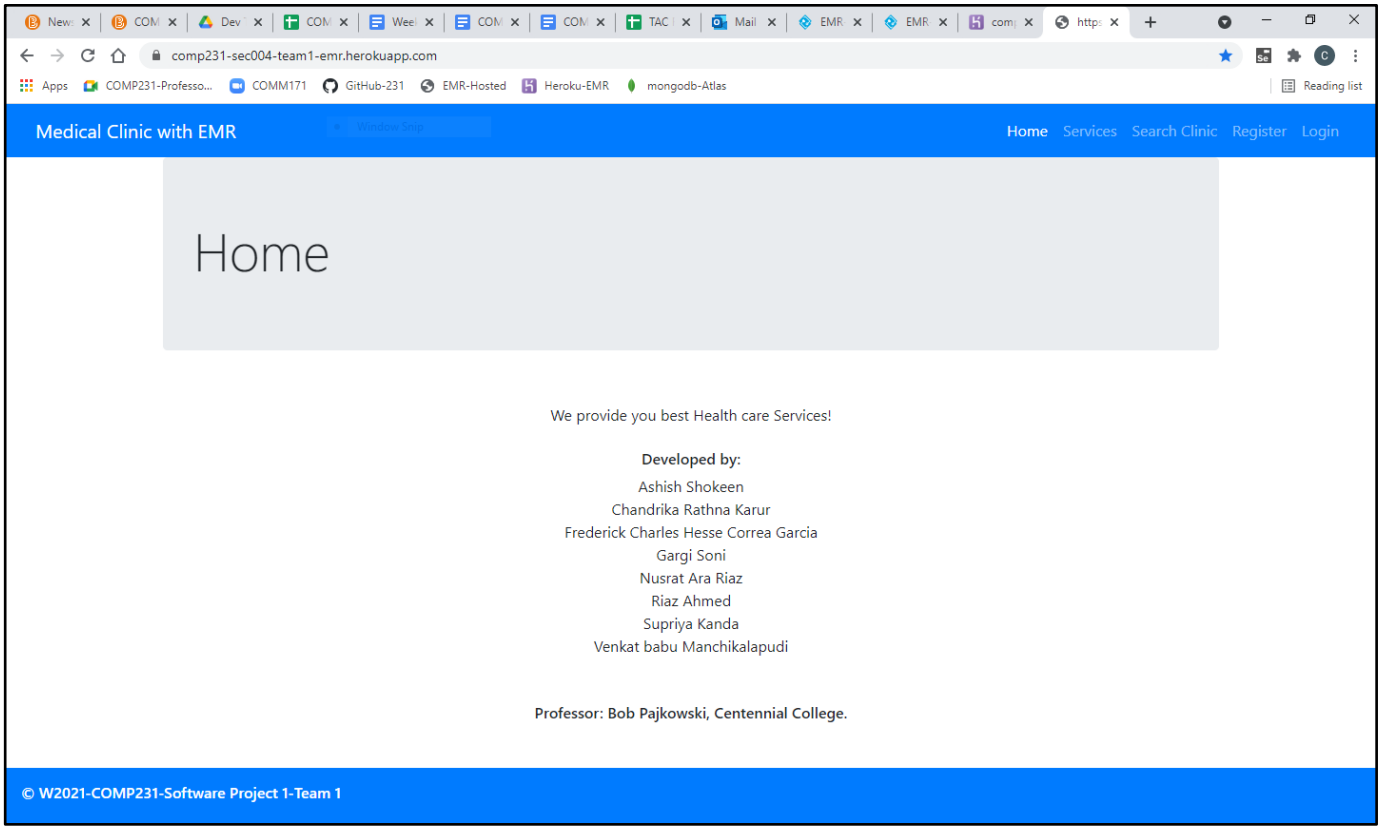


Figure 18: shows the home page of Clinic with EMR

Step 2 : Login (Register if you have not yet registered)

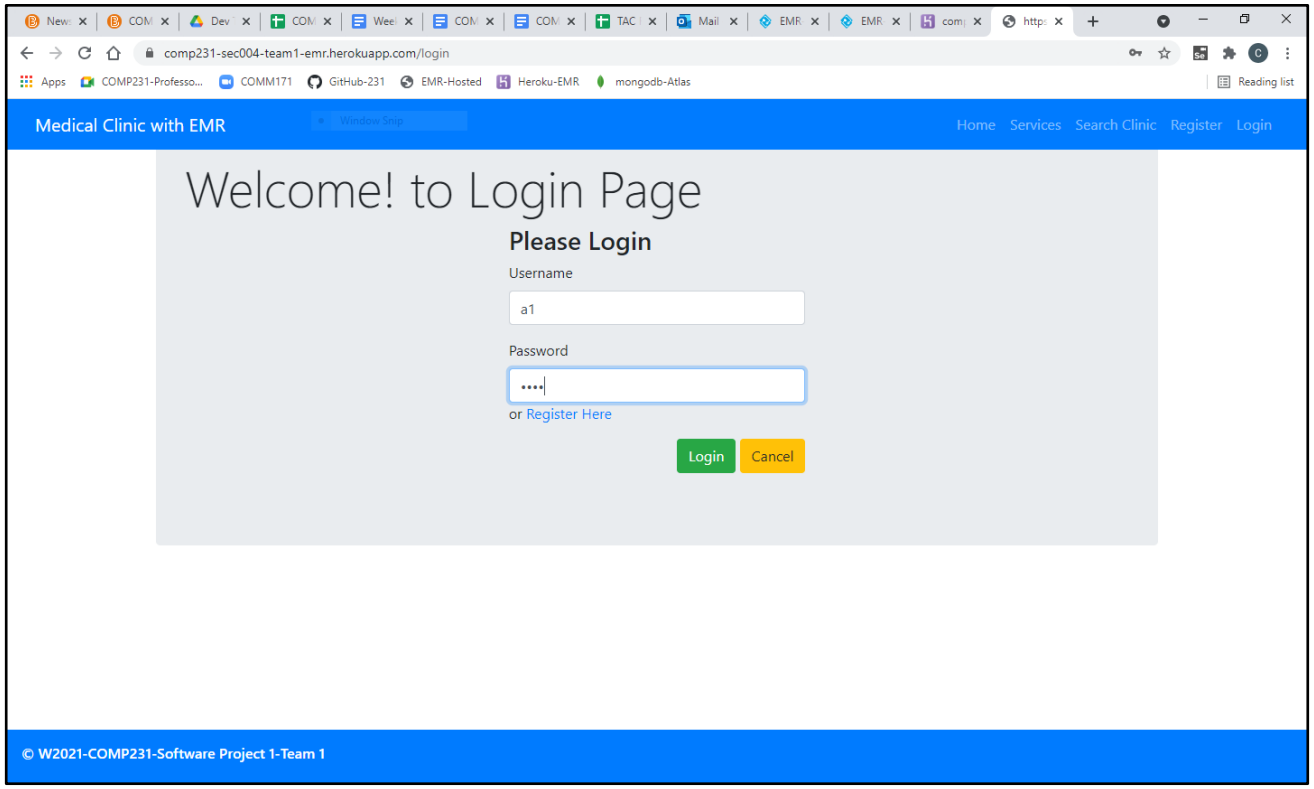


Figure 19: Showing the login page

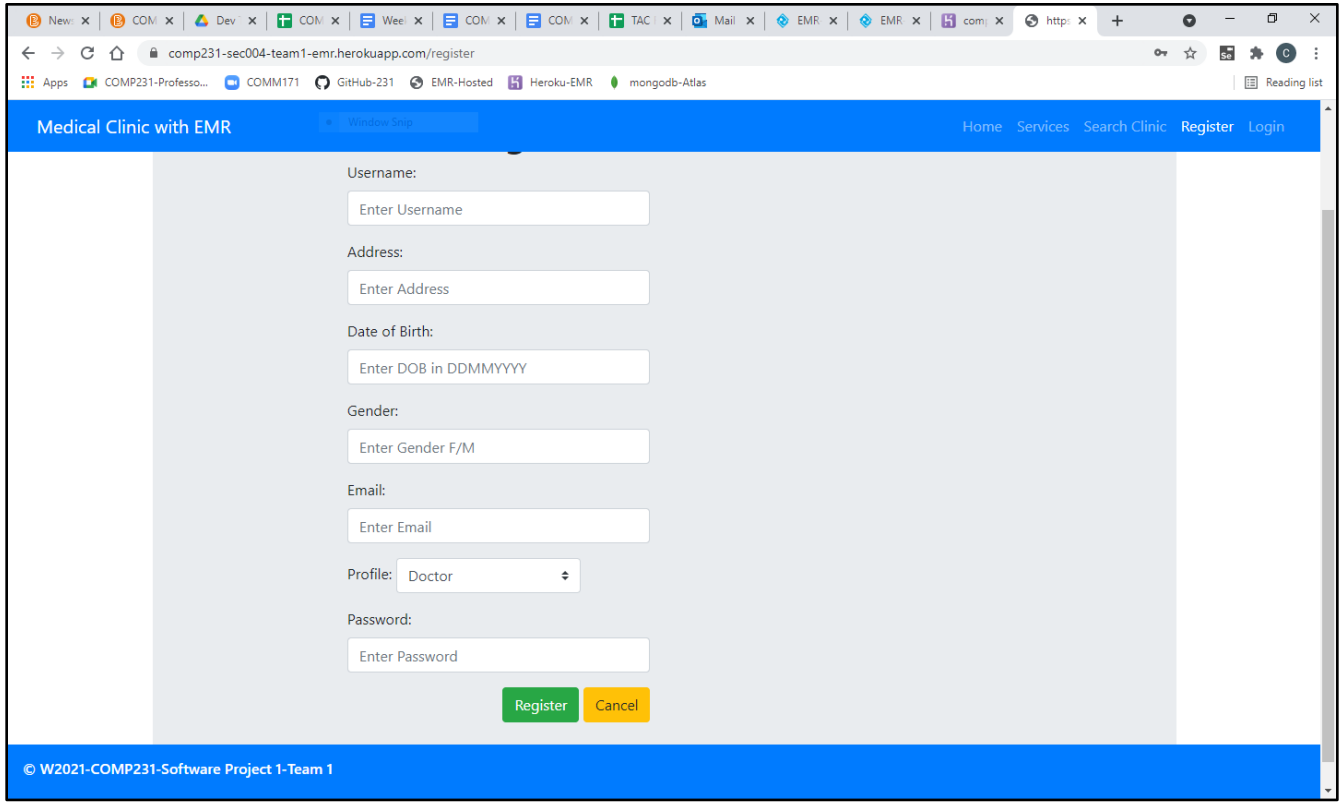


Figure 20: Showing Registration page

Step 3 : If you are a

a. Patient: you can view your records on the home page

b. Doctor: you can view the records of all the patients, you can add a new record using the add button on the top or edit /delete by clicking the respective button on the record.

c. Nurse: you can view the records of all the patients, you can add a new record using the add button on the top or edit /delete by clicking the respective button on the record.

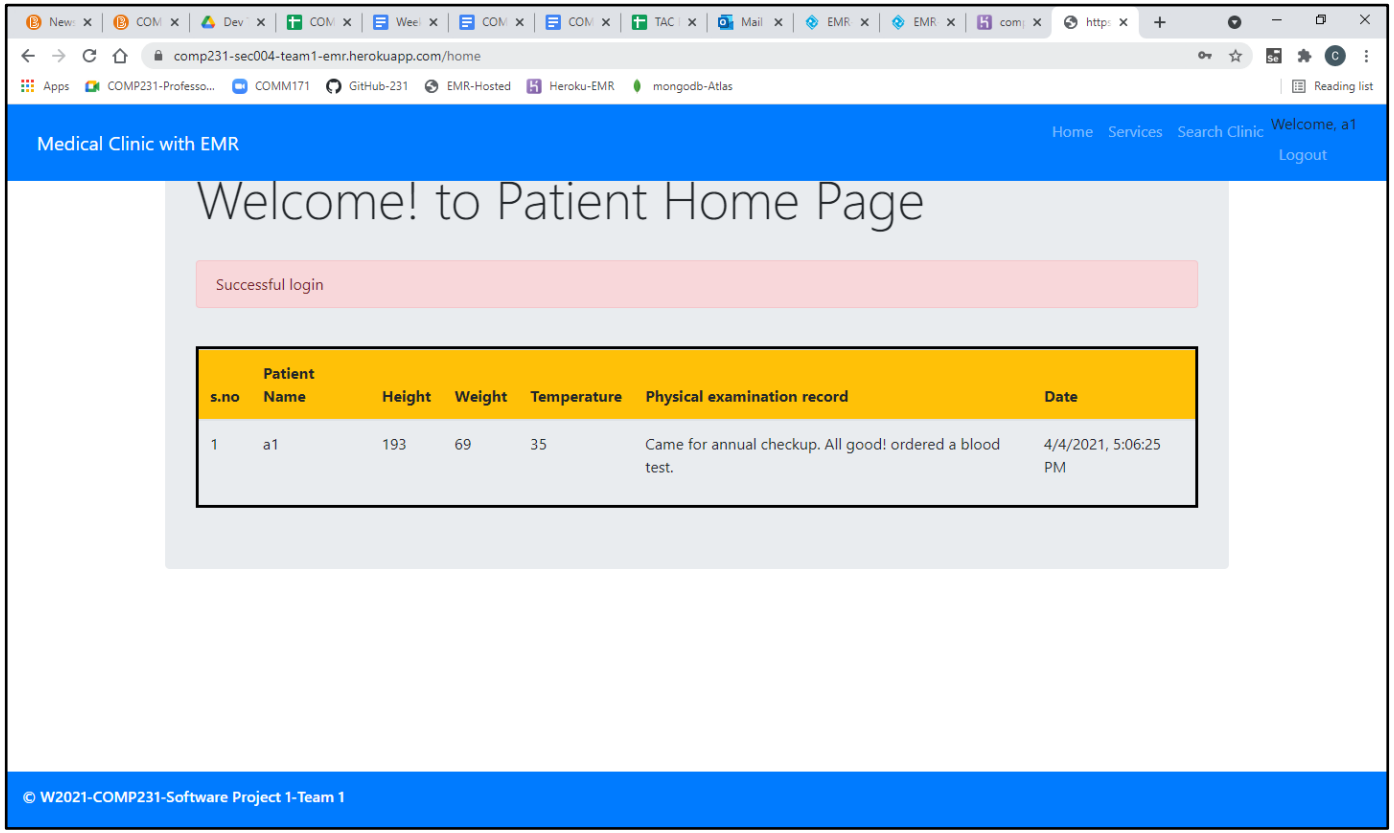


Figure 21: Showing Home page of a Patient with his/her record

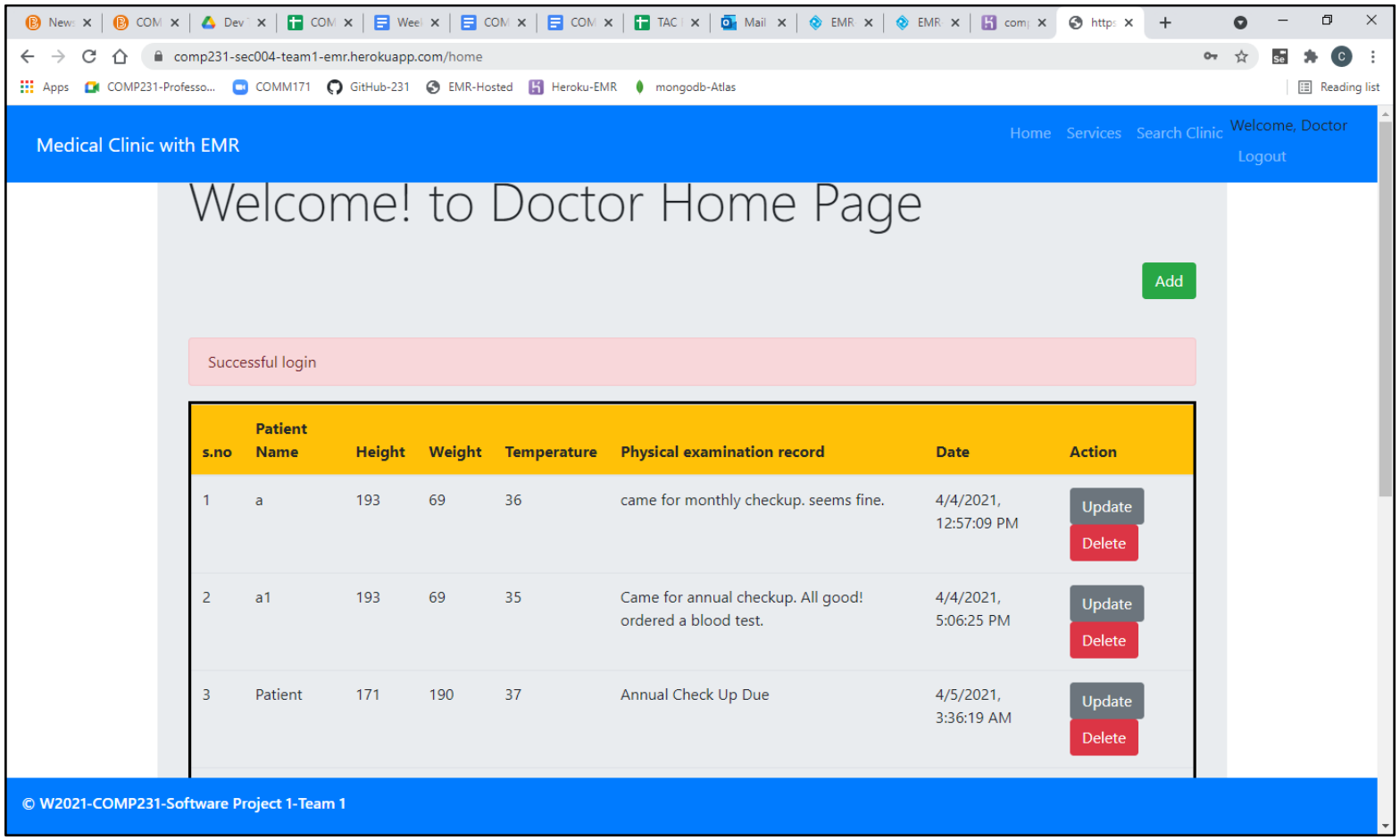


Figure 22: Showing Home Page of Doctor with list of all the patient records

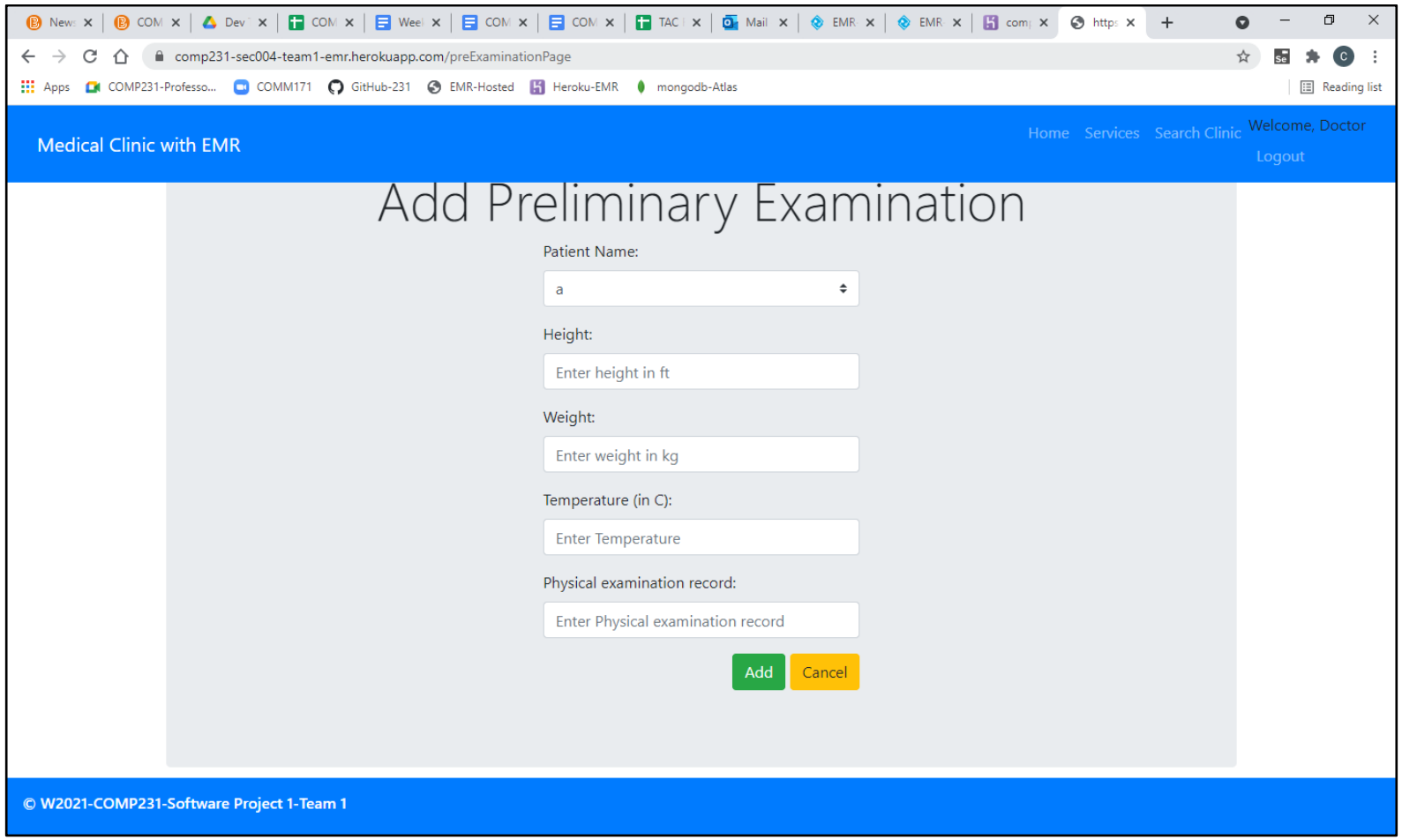


Figure 23: Showing Doctors view of Adding a new Patient record

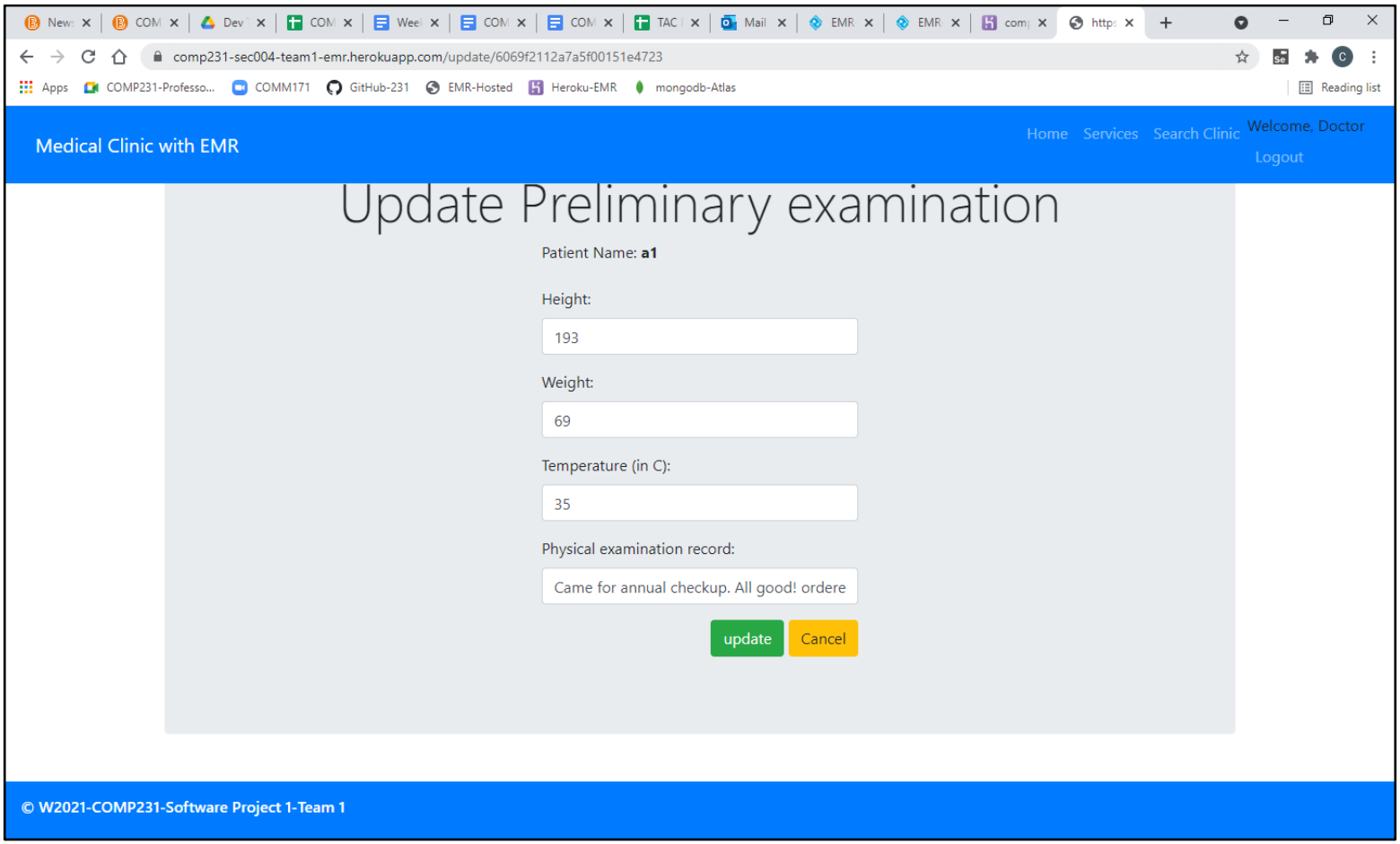


Figure 24: Showing Doctor's View of Updating an existing record.

Step 4 : Logout once you are done.

ADMINISTRATOR MANUAL

System setup and configuration of the back-end system

Our Solution to EMR is a Web Application. Technologies used are listed below. The code is coded using visual studio code with mongodb as the URI and then pushed onto github, the github code is then linked in Heroku to deploy and host the EMR app. (Note: Please contact the team for username and passwords)

- Development tools/technology: Express.js, Bootstrap, Node.js, NPM, Visual Studio Code.

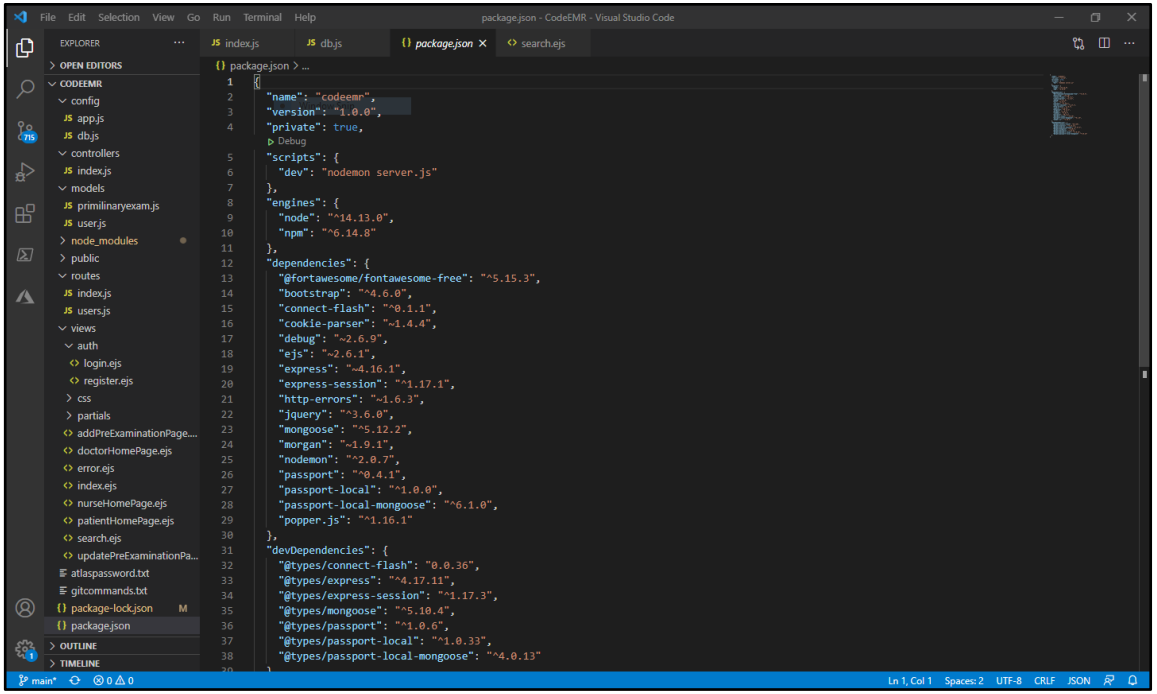


Figure 25: Displaying the packages installed through package.json file

- Web Hosting (Paas): Heroku
  - Deployment URL: https://dashboard.heroku.com/apps/comp231-sec004-team1-emr/deploy/github

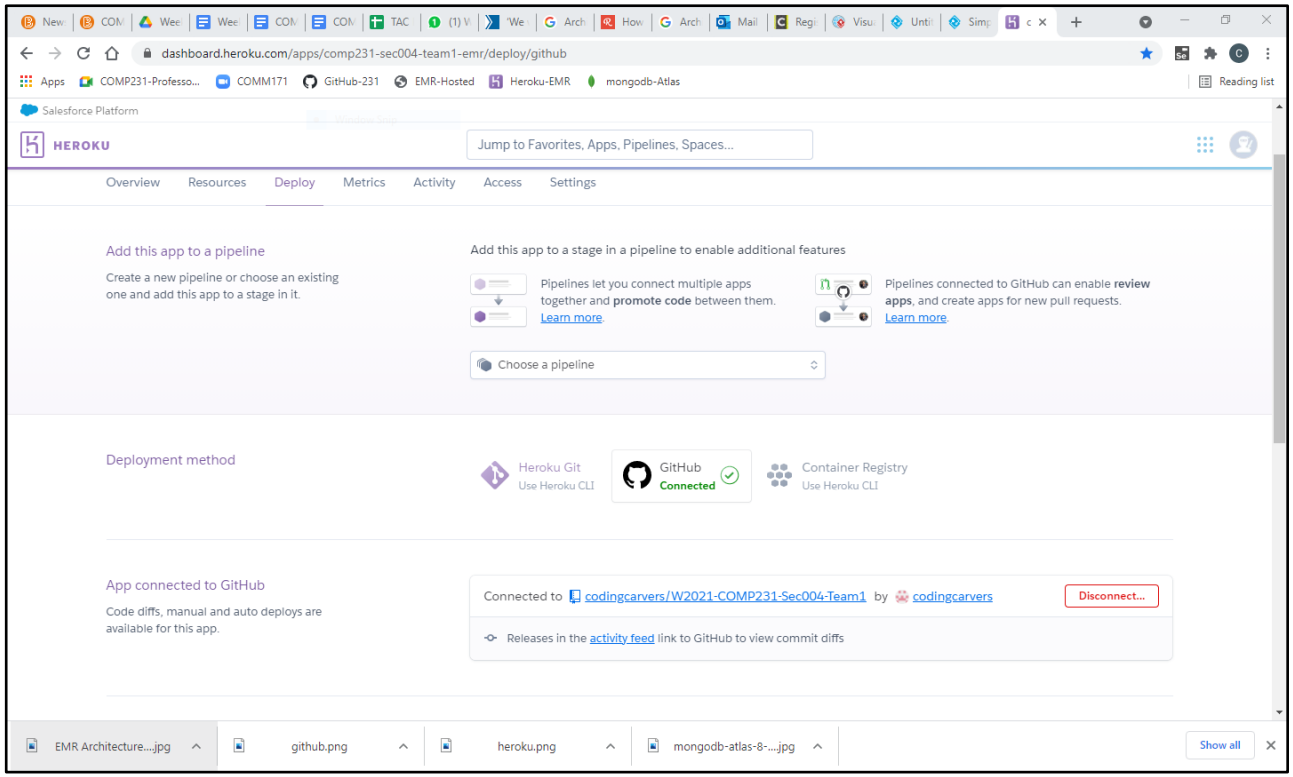


Figure 26: Showing website deployment using Heroku by connecting to github

- Database Hosting (Iaas): MongodbAtlas
  - URL: https://account.mongodb.com/account/login?n=%2Fv2%2F60577734f05a1024c1e56c24&nextHash=%23clusters

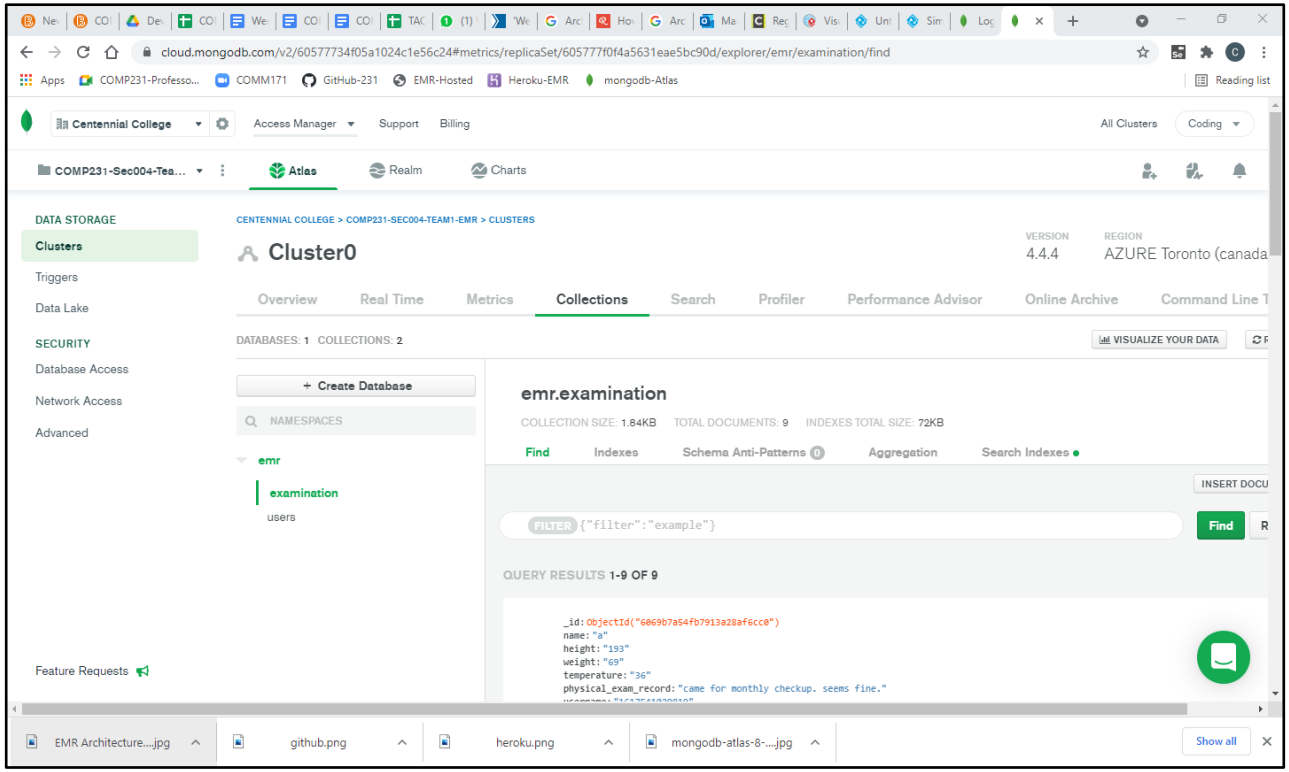


Figure 27: Showing activity on the database cluster hosted on MongoDB Atlas

- Version control: github.
  - URL: https://github.com/codingcarvers/W2021-COMP231-Sec004-Team1

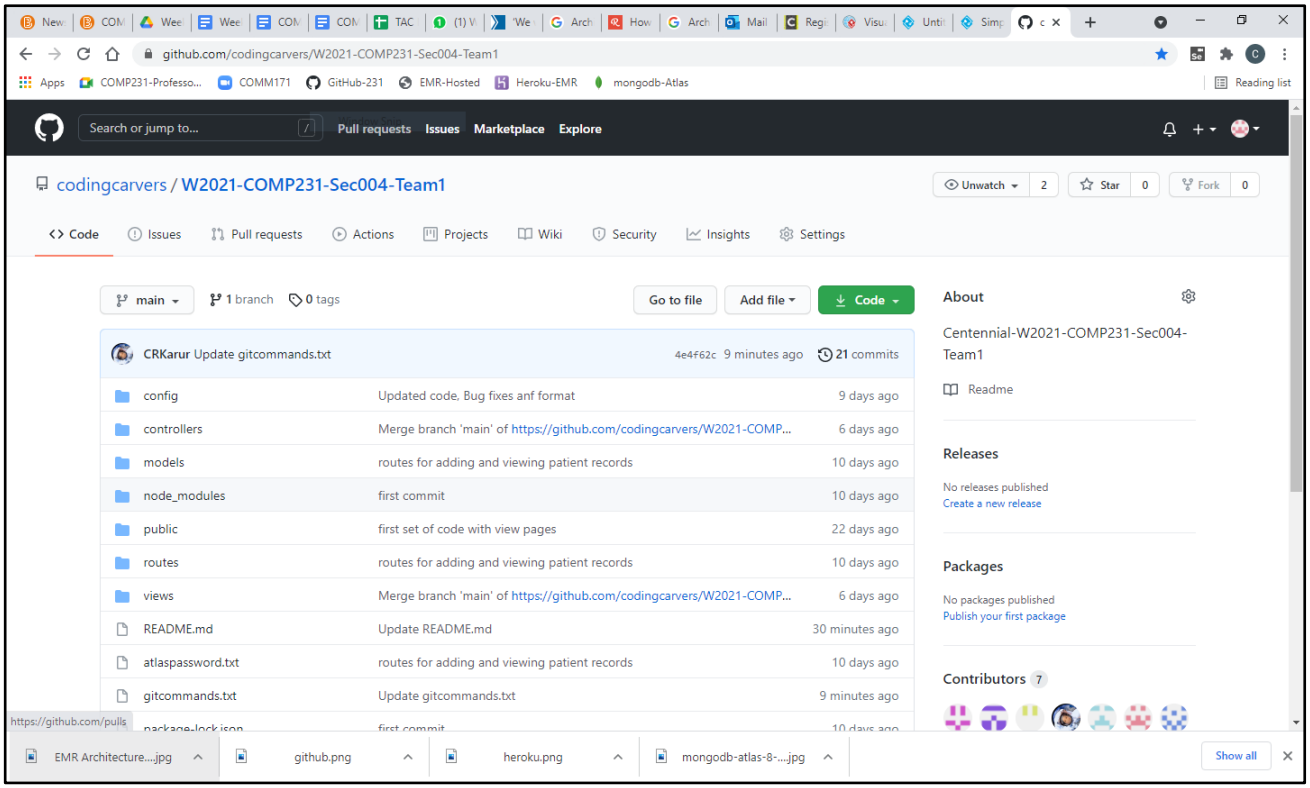


Figure 28: Showing Github repo for the project EMR

- EMR WebSite URL: https://comp231-sec004-team1-emr.herokuapp.com/

APPENDIX D (PROGRESS MONITORING)

Progress Monitoring:

Story points were calculated and tracked at the beginning and at the end of both the iteration[1] and iteration[2]. The Table 13 below shows the tracked story points at the two iterations. Figure 27 below shows the burndown chart based on the data represented in Table 13.

Table 14: Progress and changes for iterations [1] of EMR Release 1.0.

Description	Iteration 1	Iteration 2
Story points at the start of the iteration	192	171
Story Points Completed during iteration	33	60
Changed estimates	6	-16
Changed story points from new stories	6	4
Story Points at the end of the iteration	171	99

Burndown Chart:

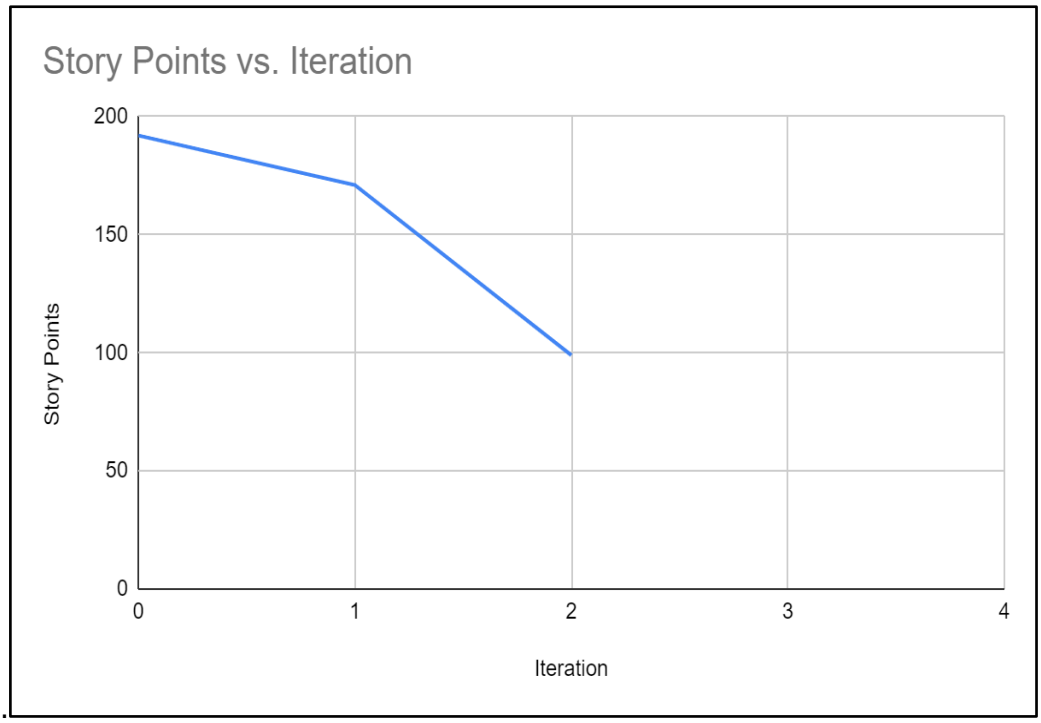


Figure 29: shows the iteration burndown chart of the data from Table 12.

APPENDIX E (GNU Free Documentation License)

GNU Free Documentation License, Version 1.0, 18 April 202

“The Free Software Foundation (FSF) is a nonprofit with a worldwide mission to promote computer user freedom. We defend the rights of all software users.”