D2 Software Requirements Specification
Project : Healthcare Appointment Booking System
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Project repository: https://github.com/angie-W-auemail/groupproj_3506.git

1. Introduction

1.1 Purpose

Purpose and goals

- This project is intended to build an online booking system for a healthcare service organization.
- The booking system is intended to support the organization's daily business activities and generate records and data storage. The new system is intended for admin staff, doctors, and patients with different id access for their granted permissions. The admin staff will have highest permission to manage users, grant permissions, daily schedules, pricing, track records, and generate reports. The doctors will have permissions to manage personal profile and schedules, track and generate records, provide feedback/recommendations to patients. Patients will be able to view schedule availability and book appointments, view visit history and treatment progress, make payments and receive medical reports, and update personal details and manage account settings.

Problems aims to solve

- The current manual booking system is processed through phone or walk-in style that are slow and prone to errors. Patients were experiencing access inconvenience on working hours, long wait time due to phone capacity, and possibly scheduling conflicts due to manual errors. The new booking system is automated, displaying schedules online 24/7, which will solve the long wait time, access restrictions, and eliminate space for manual booking errors.
- Patients will have to visit the organization for payments and retrieving medical reports, since the current system relies on paper, it's hard to track their appointment history and treatment progress statistics. The project system will grant patients with online access to their personal data.
- The system also helps doctors to manage and retrieve schedules, patient data, medical records online, and provide feedback and recommendations with patients online creating new communication channel

Audience

- Developers: Vishali Chhabra, Angie Wang, Troy Johnson , Cordelle WaldenCameron
- Project manager: Angie Wang
- Tester: Vishali Chhabra, Angie Wang, Troy Johnson , Cordelle WaldenCameron
- Target end-users of the project: HR Admin staff, doctors, patients

The new system will replace the current phone-based or walk-in booking system on paper where registration and data storage are on recorded physical files.

1.2 Scope

- The booking system will allow users to log in as admin, doctors or patients with different permission access.
- For the admin staff, the system will grant permission to manage users, appointment schedules, doctor availability, and pricing. Admin staff may also track patient appointments, payments, and medical history, assign roles and permissions to doctors and patients, and generate reports on patient engagement and revenue.
- For the doctors, the booking system will grant permission to manage appointment schedules and view patient details, track patient treatment history and update medical records, provide feedback and recommendations to patients, manage personal profile and availability.
- For patients, the system will provide service to book appointments with doctors and view availability, track appointment history and treatment progress, make payments and receive medical reports, and update personal details and manage account settings. Booking system will allow patients to set up appointments and make payments, it will not allow cancellation and refund online, and patients will have to contact the organization if desired.

1.3 Definitions, Acronyms, and Abbreviations

API (Application Programming Interface): software application with user friendly interface

user interface (UI): point of interaction between end user and digital device or application

CRUD: create, read, update, delete

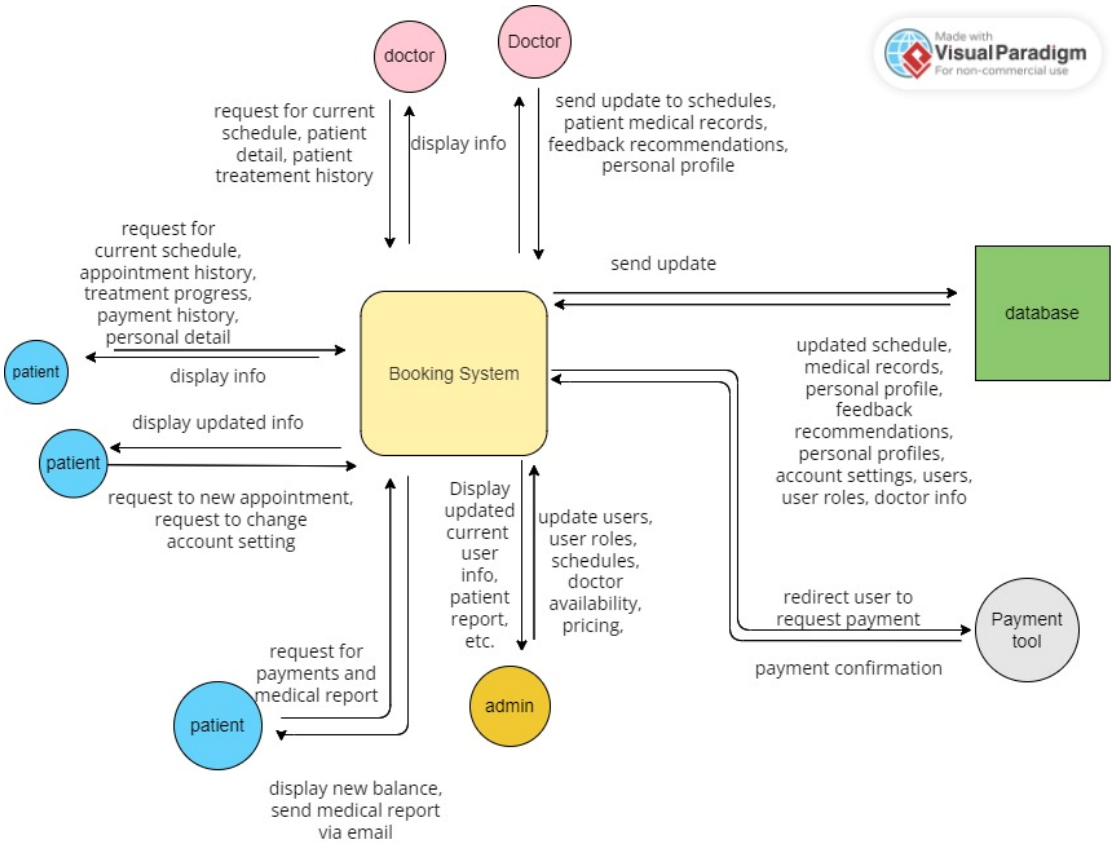
1.4 Overview

Contents

2. Overall Description

2.1 System Perspective

The new booking system fits as an upgraded daily tool to the current phone-based, walk-in based registration system, it will improve registration availability and work efficiency, decrease the amount of frictional time. Since we are allowing online payment from patients, the booking system may interact with paypal or other online payment tools to request for transactions.



2.2 System Functions

The system will allow users to log in as admin/patient/doctor. Users will send requests to update appointment schedules, patient details, historical records, payment history, personal profile, account settings, user account roles, doctor information pricing, etc. System will display current information after updates according to the role permission. Patient account will be able to make requests for payments and medical reports, the system will redirect and send requests to payment external tools, and the system will automatically send reports via email after request.

2.3 User Characteristics

- **Admin:** manage users, user role, appointment schedules, doctor availability, and pricing; track patient appointments, payments, and medical history; assign roles and permissions to doctors and patients; and generate reports on patient engagement and revenue.

- **Doctors:** manage appointment schedules and view patient details, track patient treatment history and update medical records, provide feedback and recommendations to patients, manage personal profile and availability.

- **Patients:** book appointments with doctors and view availability, track appointment history and treatment progress, make payments and receive medical reports, and update personal details and manage account settings.

2.4 Constraints

- The system must comply with the GDPR for data privacy.
- system must process 1,000 transactions per minute at maximum
- System must be able to process on low-power device

2.5 Assumptions and Dependencies

- The system assumes the availability of a stable internet connection for real-time updates.
- The system assumes on good practice from patients where they don't double book and show up timely
- The system assumes best practice by doctors input new entry of comments and medical record at every new visit from a patient
- The system assumes payment up-front, patients will have to pay the amount due before successfully booking an appointment, the system does not allow cancellation and refund online, and patients will have to contact the organization for such matters.

3. System Features

3.1 Feature Description

Feature 1: User Authentication
Description: The system shall allow users to create an account, log in as admin/doctor/patient, and reset their passwords.
Inputs: Username, password.
Processes: Authentication checks using encrypted credentials.
Outputs: User authentication token, success or failure message

Feature 2: retrieve data
Description: Load the current appointment schedule/account details(doctors and pricing , profile/patient detail, patient medical history, recommendations to patient, etc.), etc. according to the user account permission
Inputs: user account
Processes: connect to database and retrieve all data for the account matching for display, trigger the refresh for UI display
Outputs: refreshed interface

Feature 3: request to update data
Description: users send requests to update the current appointment schedule/account details(doctor pricing , profile/patient detail, patient medical history, recommendations to patient, etc.), etc.
Inputs: updating entry, category of update (table name, line of entry), user account permission
Processes: categorize user account, validate for permission to update, retrieve data table by category, send request to feature 4, call feature 2 to refresh and display new data
Outputs: updated database and refreshed interface

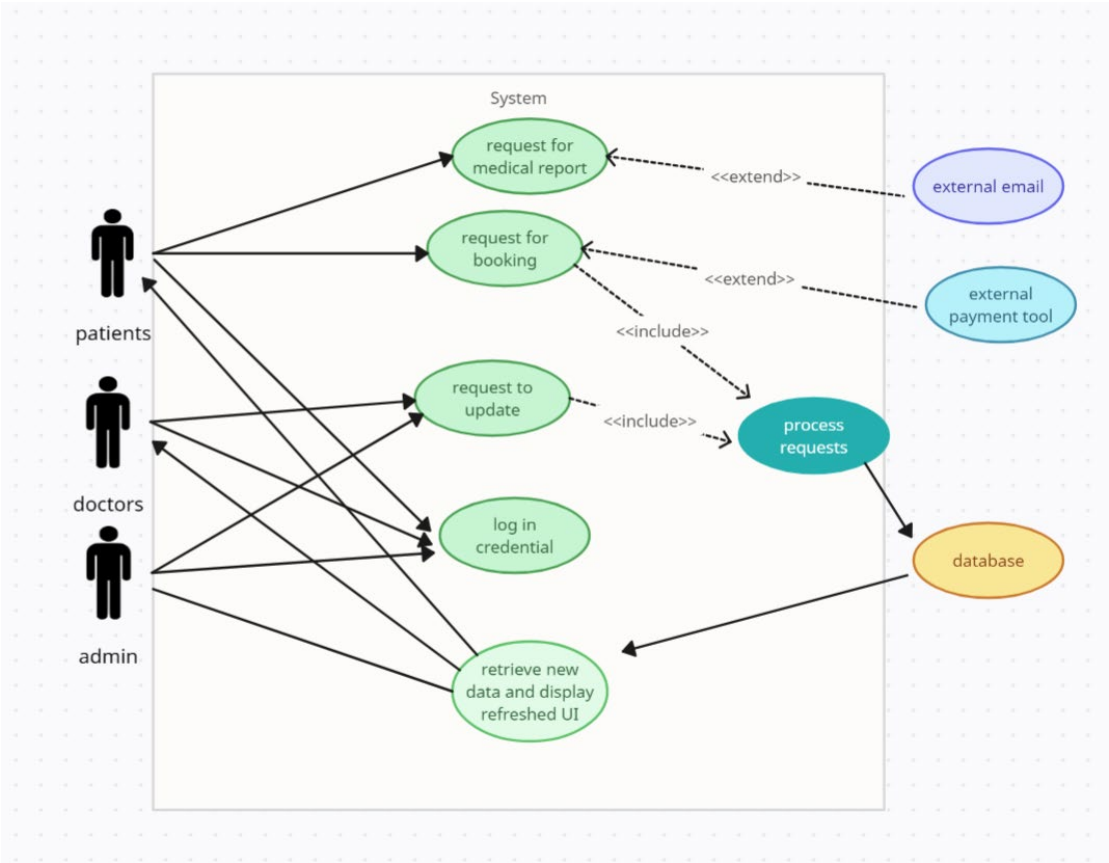
Feature 4: Processing update request
Description: feature 3 sends update entry (entry to be created, updated, deleted) to be processed, retrieve current data table accordingly and validate if update applicable. If yes then update the data table and return new data table
Inputs: updating entry, category of update (table name, line of entry), user account permission, database credentials
Processes: check if the date requested has passed, no change of historical data, warning message return. If no exceptions are caught, connect to the database and query to enter a new entry to the table or change current entry accordingly.
Outputs: updates to database

Feature 5: Request to book appointment (make payment)
Description: patients can make payments online through the booking system, after booking new appointment to schedule, pop up page displaying amount due with taxes and connect to external payment tools for the amount, return with payment confirmation and request to update payment history table
Inputs: patient id, amount payable
Processes: After patient selecting and confirming on booking schedule, check if availability is empty then process, if not then return warning message and keep current data, if schedule is empty then pop up UI for payment gateway, display amount due and connect to external payment tool, after payment, display verified payment and request to update schedule and payment history, display refreshed new schedule with booked name and hour
Outputs: updated schedule, updated payment history, refreshed UI display

Feature 6: Request to medical report
Description: patients can make request for medical report, report is then sent to registered email
Inputs: patient id
Processes: User request for medical report, connection to database and retrive patient details, patient treatment history, medical records, doctor feedback and

recommendations, generate a medical report and send the report to patient's email
Outputs: medical report sent to email

3.2 Use Case Diagram Integration



4. External Interface Requirements

4.1 User Interfaces

Login page

The login page will contain fields for username and password, a 'Forgot Password' link, and a submit button.

Home page

User home page options different for admin, doctors, and patients

admin

- Options to users page,
- Options to schedule page
- Options to current admin's user profile page

Doctor

- Option to their own schedule page
- Option to current patients page (users page)
- Option to the current doctor's personal profile page

Patients

- Options to current patient's user profile page
- Option to appointment schedule page

Users page

- **Admin:** Display all registered users including patients, doctors and admin staff, option to create new line of user, option to delete user, option to update user information, option leads to each user's detail page
- **Doctor:** display current patients (patients who have booked appointments with this doctor), option leads to each user's profile page
- Option to go back to home page

User profile page

- Display name, personal information, permission level (doctor, patient, admin), email, doctors' profile page will have pricing listed, patients page will have treatment records, medical history, transaction history, appointment history, doctor's comments and suggestions
- (available to all users) Option to update profile information (permission/pricing change not available here), and account setting, and to go back to home page
- For doctors logging into this page at patients' visit, options to add entry to treatment records, medical records, and comments section
- For patients logging into this page, options to generate medical report sent by email

Appointment schedule page

- Admin and patients can select a doctor and open their current schedule availability, display doctor name and pricing header, doctor will head to their own schedule page

Admin

- CRUD of appointments (able to delete and update)

Doctor

- CRUD of appointments (able to delete and update)

Patient

- Request to create appointment, unable to delete and update, only empty schedule space can be filled, lead to external payment page and return at payment verification

Payment verification page

Payment receipt of order, doctor name, appointment time, amount paid, option to go back to the appointment page

4.2 Hardware Interfaces

The system will require computer device with internet to log in and use

Client Devices (Patients, Doctors, Admins): Both patients, doctors and admins are expected to connect to the system using a browser or mobile applications.

Printing Equipment: Useful for printing patient files, as well as the schedules for both the scheduled appointments and the expected reports.

Card readers/Credit Card processing terminals: For processing payments face-to-face with patients within clinics or hospitals.

Servers

There are three types of servers that will be required:
1. **Application Server**: Responsible for containing the backend, execution and scheduling of user's request along with the functioning of the system.
2. **Database Server**: This server plays the role of storing the data received from patients, when doctors are available, when the appointments are made and other system settings.
3**. Backup Server:** Which involves keeping a regular copy of the database and the most important functions in record to the working of the system.

Networking Devices

Routers, Switches, Firewalls: These Provide secure and high quality internet access for the users as well as communication between components.

Load Balancers: Used to ensure that servers are not bogged down by having one or few servers responding to every request and others doing nothing.

4.3 Software Interfaces

Operating systems:

Client-Side: Windows, macOS, Android, iOS. (This will be used if the user tries to use the system from the device using a web browser or an app.)

Server-Side: Linux and Windows must also be used for the backend as well as the database.

Web Browsers: Google Chrome, Mozilla Firefox, Safari, Microsoft Edge - The system must work well with current web browsers.

APIs

SMTP/Email APIs: Ability to send email notifications and warnings.

Payment Gateway APIs (PayPal): Ability to accept secure online payments.

Database Management System (DBMS)

MySQL: Setting up and managing the application's relational database, and also managing user data and scheduling of appointments are very common features in most of the applications.

Authentication Systems

OAuth 2.0: Its main purpose is to authenticate users by way of third party services, for instance, Google

Electronic Health Record (EHR) Systems: The system is also able to be integrated with the current healthcare management systems to avoid having different records for the same patient base.
Calendar Integration(Google calendar): Usually this integration allows for the synchronization of appointments with external calendars.

4.4 Communication Interfaces

Web Interface (HTTP/HTTPS)

The Web interface will allow patients, doctors and administrators to interact with each other using very secure web systems.

Mobile App Communication (HTTPS)

For this, the mobile applications will trigger communications with servers via https and will implement the REST apis calling them for the creation of timetables and other notifications.

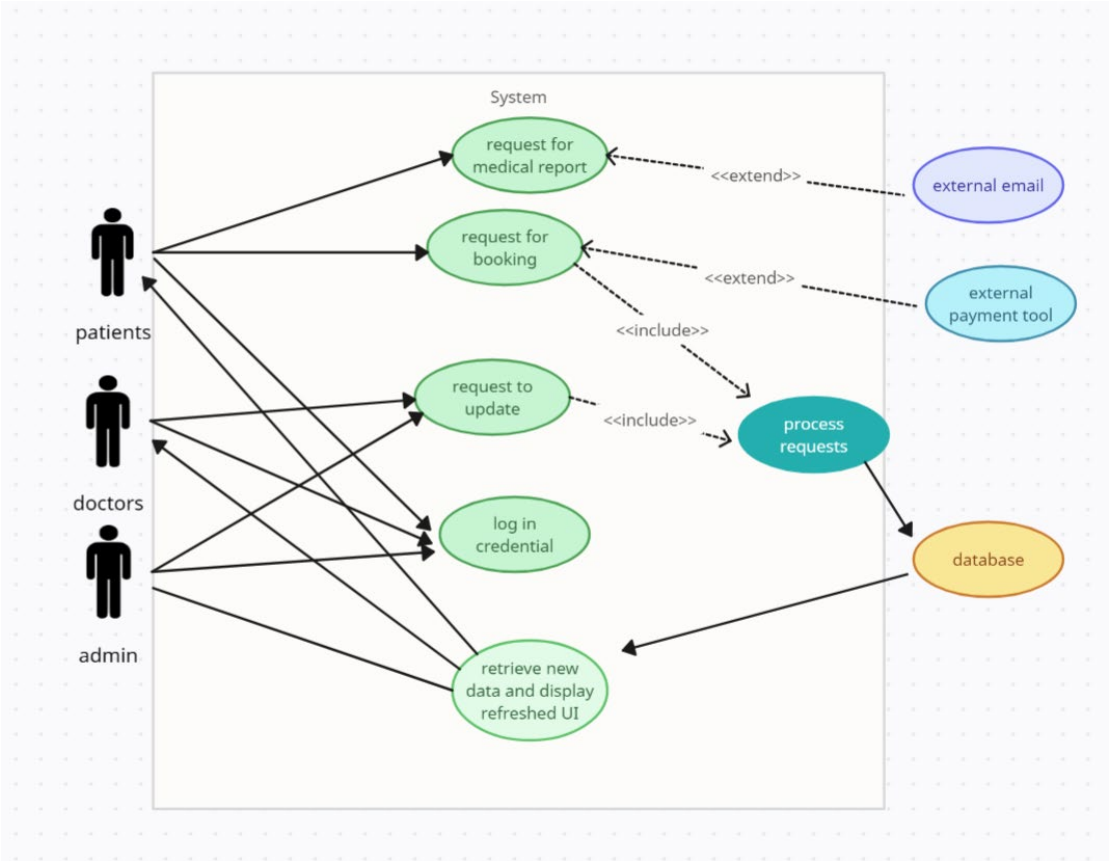
Email Communication (SMTP)

Users will receive automatic email notifications as and when appointments are confirmed. These include Gmail for the sam2 purpose.

Payment Gateway (HTTPS)

The PayPal APIs over https are crucial for safe payments made for bookings.

5. System Models



6. Non-Functional Requirements

6.1 Performance Requirements

· **Response Time:** To provide a seamless user experience, the system must react to user activities, such as scheduling an appointment or accessing patient details, in less than two seconds.

- **Throughput**: At least 500 people should be able to log in at once without experiencing any performance issues. It must also be able to handle 10,000 requests per minute or more with a response time of less than two seconds. This guarantees that the system can effectively handle heavy traffic without slowing down during peak hours, such as early mornings or late evenings when patients are more likely to schedule appointments.

6.2 Security Requirements

- **Data Encryption**: Using SSL/TLS protocols, all user data—including private data and medical records—must be encrypted while in transit. To prevent unwanted access, sensitive data must also be secured when it is at rest using industry-standard encryption techniques (such AES-256).
- **Data Protection:** Encryption must be used to protect sensitive patient data while it is in transit and at rest to prevent data breaches from exposing private health information.
- **Access Control:** Use role-based access controls (RBAC) to make sure that only individuals with the proper authorization, such as administrative staff and

healthcare practitioners, can access data according to their roles. This will preserve compliance with laws like HIPAA and stop unwanted access to private patient data.

6.3 Usability Requirements

- **System Uptime:** To ensure that it is virtually always available for use, the system must maintain an uptime of 99.9%. To reduce the amount of time that patients and healthcare providers are inconvenienced, critical failures must be fixed within two hours.
- **User Interface**: The system should have an intuitive and user-friendly interface that allows patients and staff to complete appointment bookings within a maximum of 3 clicks. This reduces user frustration and enhances the overall experience, making it easier for patients to schedule appointments without extensive training or guidance.

6.4 Reliability and Availability

- **System Reliability**: To provide high availability for consumers, the system must maintain a 99.9% uptime rate. Resolution activities need to be carried out in two hours in case of a critical failure in order to quickly return normal operations.
- **Error Recovery**: The system must be capable of recovering from failures within 5 minutes while retaining transaction integrity. This includes mechanisms to ensure that any in-progress transactions are either completed successfully or rolled back without data loss.

6.5 Maintainability

- **Code Modularity**: The system must be modular to allow for the updating or replacement of specific parts (such as user authentication or appointment scheduling) without affecting the functionality of the system. This makes maintenance and upgrading simpler.
- **Documentation**: Both consumers and developers must have access to thorough documentation. This includes troubleshooting, onboarding new employees, and maintenance with the help of user manuals, API documentation, and system architectural overviews.

6.6 Scalability

- **User Load**: Up to 10,000 concurrent users must be supported by the system during peak periods, such as the flu season or the launch of new services, and it must be built to scale horizontally. This comprises cloud infrastructure capabilities that can dynamically distribute resources in response to demand and load balancing provisions.
- **Data Growth**: The database must be able to accommodate a 20% annual increase in patient records without experiencing performance problems. Efficient database design, indexing techniques, and data archiving rules are necessary to guarantee prompt access to current records while preserving system efficiency.
- **Future Scalability**: As the healthcare institution grows its services or user base over time, the architecture should support further scalability beyond the current

requirements, accommodating an increase in users and data traffic. These could include cloud-based solutions that make resource allocation and easy scaling in response to changing needs possible.

7. Other Requirements

7.1 Legal and Regulatory Requirements

This system will be required to comply with the Connected Care for Canadians Act, the Personal Information Protection and Electronic Documents Act(PIPEDA), and the Public Hospitals Act.

7.2 Scalability and Future-Proofing

- System must be able to handle an ever increasing number of users and appointments.
- Data retention system must be changelable as laws get updated.

7.3 Data Retention and Archiving

- The Public Hospitals Act says personal client health information must be retained for 10 years since the last entry for those 18+. If under 18 information must be kept until the client is 28.
- Data must be deleted upon user request.
- Data retention system must be changelable as laws get updated.

8. Appendices

8.1 Glossary of terms

SSL	Secure Sockets Layer
TLS	Transport Layer Security
JSON	JavaScript Object Notation
API	Application Programming Interface
HTTPS	Hypertext Transfer Protocol Secure
CRUD	Create, read, update and delete

GDPR	General Data Protection Regulation
SQL	Structured Query Language

8.2 References

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