



SC2002: Object-Oriented Design & Programming

AY24/25 Semester 1 Group Assignment

HOSPITAL MANAGEMENT SYSTEM

Declaration of Original Work for SC2002/CE2002/CZ2002 Assignment

We hereby declare that the attached group assignment has been researched, undertaken, completed, and submitted as a collective effort by the group members listed below.

We have honored the principles of academic integrity and have upheld Student Code of Academic Conduct in the completion of this work.

We understand that if plagiarism is found in the assignment, then lower marks or no marks will be awarded for the assessed work. In addition, disciplinary actions may be taken.

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1. Design Consideration

1.1. Design Approach

The HMS was designed with the purpose of automating hospital operations. Classes were modeled after real staff roles or entities, grouped into 3 main packages: *appointments*, *users*, and *medication* to manage appointments, perform user operations, and manage medication inventory respectively. An additional *utils* package provides utility operations such as reading from, writing to and managing data in files.

Tight cohesion was achieved by modeling the class in the packages after real entity such as Patient, Doctor, or Medication, with all but only the expected operations/attributes. All attributes and methods were implemented to achieve consistency and minimize complexity.

Loose coupling was achieved by injecting abstractions/interfaces such as *IMedication* between the interactions of higher- and lower-level modules to remove direct dependencies, so that changes in one class do not affect others depending on it.

1.2. Assumptions

1. Different types of users have different corresponding types of ID.
2. Appointment status by default is “available”. After user makes an appointment, it’s in “pending” state for approval from the doctor. It’s then “confirmed” or “declined” based on doctor response. After a “confirmed” appointment has happened, it’s “settled”.

1.3. Applied Design Principles

1.3.1. Single Responsibility Principle

“A class should only have a single reason to change”. This serves to minimize the ripple effect of changes to the system. For example, *Doctor* class in the system only have attributes and actions which are specific to the doctor role.

1.3.2. Open Closed Principle

“Classes should be designed to be closed for extension and open for extension”. *User* class was implemented as an abstract class to handle common interactions e.g., log in. The *User* class is extended by subclasses *Staff* and *Patient*, allowing the addition of new functions tailoring to the needs of different types of users. For instance, *Staff* class additionally implements functions to get more specific information about the staff and *Patient* class additionally implements functions enabling patients to carry out certain actions.

1.3.3 Liskov Substitution Principle

“Subclass must do all the things superclass does. Subclass must not bring any trouble that superclass doesn’t”. In the system, *Doctor*, *Pharmacist*, *Administrator* are all subclasses that can safely substitute for *Staff* class. They override functions like the *showMainPage* function without introducing extra trouble to the superclass.

1.3.4 Interface Segregation Principle

“It is better to design many specific interfaces instead of one general interface”. For printing or I/O tasks, intermediate “printer” classes are used per SRP. *MedicationPrinter* and *InventoryPrinter* are both interfaces

but serve different printing tasks, so they should be separate interfaces instead of one big *Printer* interface.

1.3.5 Dependency Injection Principle

“High-level modules must not depend on concrete low-level modules, but they should depend on abstraction”. Medication-related methods of higher-level classes depend on the *IMedication* interface to perform instead of the concrete class. Changes to *Medication* class do not force dependent classes to change if the *IMedication* interface is still adhered to.

1.4. Additional Features

1.4.1 View Appointment History

The feature is added with the aim of providing a detailed log of user’s past, declined and upcoming or present appointments. Users can refer to the history to track the information and status of appointments, to stay informed about upcoming commitments as well as to plan future ones, facilitating better time management, further enhancing the user experience and convenience.

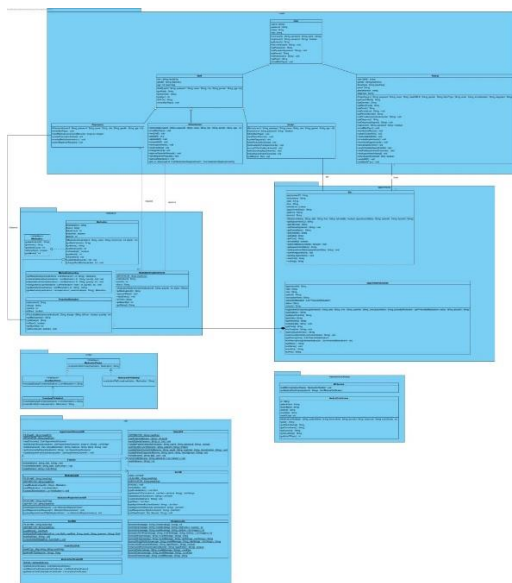
1.4.2 View Health Tips

With this feature, patients can access tailored health advice based on their medical condition. It promotes personalized care for individuals, offers convenience, saves effort in searching for health information and confirming its credibility, as well as encourages patients to actively care for their health.

1.4.3 Add Medical Certification

The feature lets doctors provide medical certificates for their patients if needed and patients can view their medical certifications, even the previous ones. Since medical certificates are managed digitally, there is a lower risk of losing important documents. Moreover, as digital documents are more shareable, the feature also improves the convenience and practicality of the system.

2. UML Class Diagram



Due to the size, please refer to the separate file for full details.

3. Test Cases & Results

3.1. Authentication (Video Link)

- Successful log in should show the correct option menu for the user.

```

Welcome to HMS!
Please select an option
1. Login as Patient
2. Login as Doc
3. Login as Pharm
4. Login as Admin
5. Exit

Please enter your userId:
P1001
Please enter your password:
password
Login Failed

Welcome to HMS!
Please select an option
1. Login as Patient
2. Login as Doc
3. Login as Pharm
4. Login as Admin
5. Exit

Please enter your userId:
P1001
Please enter your password:
password
Login successful.
Hi Alice Brown how are you?
Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout

```

- Unsuccessful log in should return to the log in screen.
- Successful log out should go back to the log in screen.

3.2. Patient (Video Link)

1. View Medical Record

- Patient views the information of themselves only.

```

4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout

1
ID: P1001
Name: Alice Brown
DOB: 1980-05-14
Gender: Female
Blood Type: A+
Email: alice@gmail.com
Phone Number: 91110002
Diagnosis: Chicken Pox

Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout

```

2. Update Contact Information

- User can choose to update their email or phone number.
- User can choose to cancel their operation to go to the option menu.
- Successful update is reflected in the medical record.

```

Patients List
1 P1001(password)Alice Brown1980-05-14(Female)A+alab@gmail.com(83767373)Chicken Pox
2 P1002(password)Bob Stone1975-11-22(Male)B+bob.stone@gmail.com(9999999999)Diabetes
3 P1003(password)Charlie White1990-07-08(Male)O-charlie.white@example.com(9122222210)Obesity

11. Logout
1
ID: P1001
Name: Alice Brown
DOB: 1980-05-14
Gender: Female
Blood Type: A+
Email: alice@gmail.com
Phone Number: 83767373
Diagnosis: Chicken Pox

Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout

```

3. View Available Appointment Slots

- “Available” appointment slots are displayed to the user.

```

Please enter your password :
password
Login successful
Hi Alice Brown how are you?
Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout

Available slots:
1) Doctor: John Smith, Date: 10-12-2024, Time: 12:12
Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout
  
```

The available slot is displayed

- If no slot is available, nothing is returned.

4. Schedule Appointment

- User gets to see and choose to schedule one of the “available” appointment slots.

```

1) Doctor: John Smith, Date: 10-12-2024, Time: 12:12
Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout

Available slots:
1) Doctor: John Smith, Date: 10-12-2024, Time: 12:12
Appointment requested, need to be scheduled/accepted by doctor
Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout
  
```

Appointment rescheduled to another available appointment

- Afterwards, the slot must not appear as an available appointment slot.

5. Reschedule Appointment

- User can see and choose to reschedule a “pending” appointment to another available slot.
- User can cancel the operation to return to the menu.

```

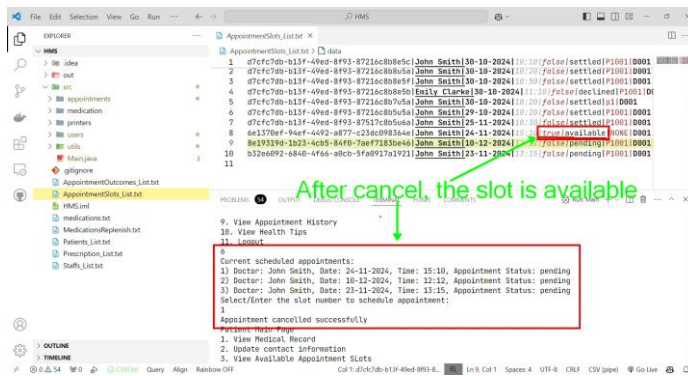
9. View Appointment History
10. View Health Tips
11. Logout

Current confirmed appointments:
1) Doctor: John Smith, Date: 24-11-2024, Time: 15:10
Select/Enter the slot number to reschedule appointment:
1
Appointment requested, need to be scheduled/accepted by doctor
Patient Main Page
1. View Medical Record
2. Update contact information
3. View Available Appointment Slots
4. Schedule Appointment
5. Reschedule Appointment
6. Cancel Appointment
7. View Scheduled Appointments
8. View Past Appointment Outcomes
9. View Appointment History
10. View Health Tips
11. Logout
  
```

Appointment is rescheduled to another slot

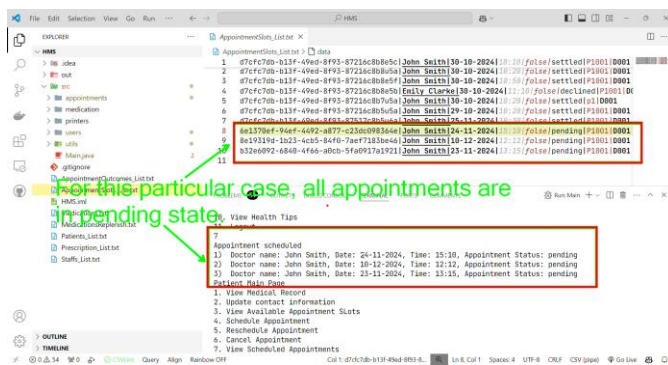
6. Cancel Appointment

- User can see and choose to cancel “pending/approved” appointment.
- User can cancel the operation to return to the menu.



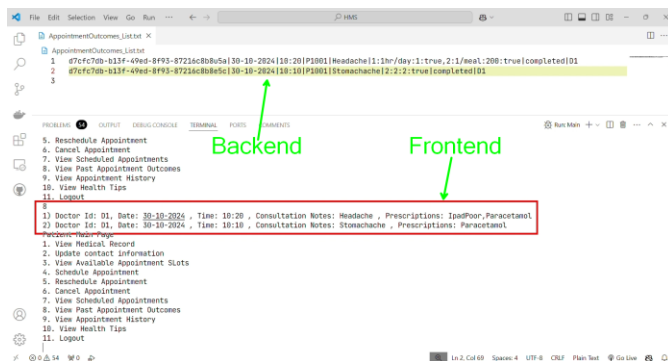
7. View Scheduled Appointments

- User can see the appointments in “pending” and “approved” state.



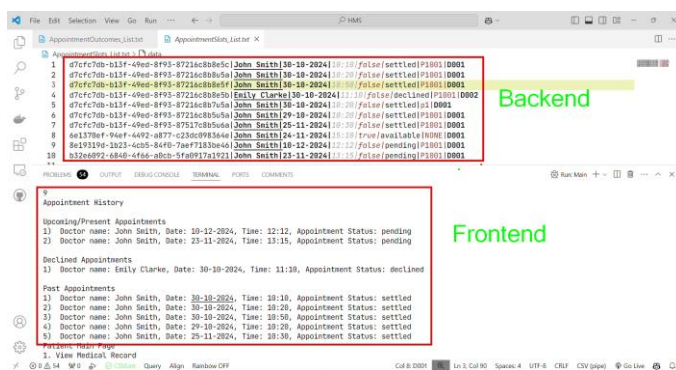
8. View Past Appointment Outcomes

- User can see the past appointment outcomes.



9. View Appointment History

- User can see the appointment history for all types of appointments (settled, pending, approved/decline).



10. View Health Tips

- User can see health tips for the condition they are diagnosed with.

- User can choose to cancel their operation to go to the option menu.
- Successful update is reflected in the medical record.

3. View Personal Schedule

- User can view all the appointment slots.

The screenshot shows a web application interface. The 'Backend' section displays a list of appointments with columns for ID, Patient Name, Date, Time, and Status. The 'Frontend' section shows a form with fields for Date, Time, Patient ID, and Appointment Status, along with buttons for 'Accept', 'Decline', and 'Cancel'.

4. Set Availability for Appointments

- User can set new appointment slots, which will be “available” by default.

The screenshot shows a web application interface. The 'Set Availability' form includes fields for Date, Time, Patient ID, and Appointment Status. A green arrow points to the 'Appointment Status' field, which is labeled 'The change is updated to the backend!'.

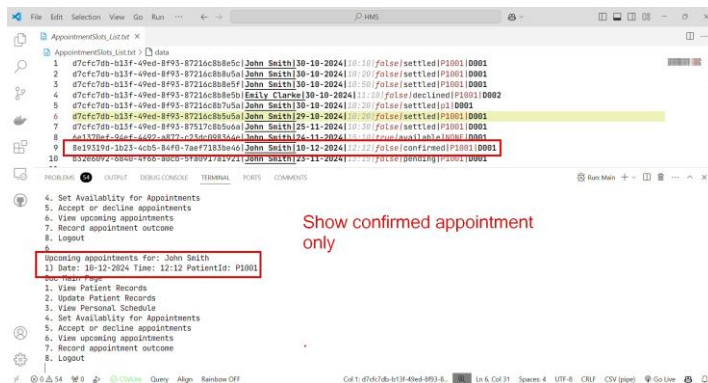
5. Accept or Decline Appointments

- User can see and choose to accept or decline a “pending” appointment.
- User can cancel the operation to return to the menu.

The screenshot shows a web application interface. The 'Accept or Decline' form includes fields for Date, Time, Patient ID, and Appointment Status. A green arrow points to the 'Appointment Status' field, which is labeled 'The change is updated to the backend!'.

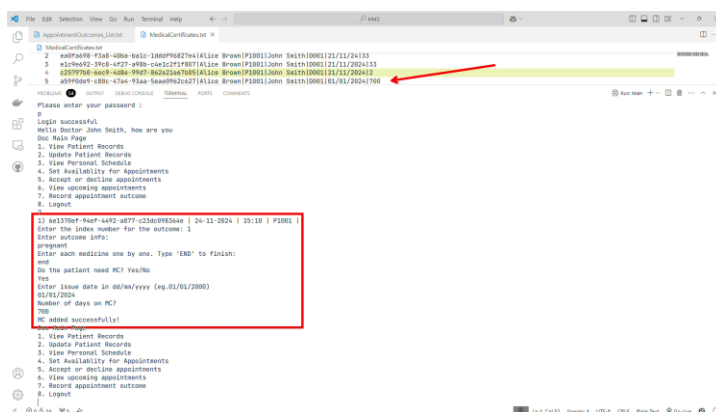
6. View Upcoming Appointments

- User can see the personal schedule of “pending” and “confirmed” appointments.



7. Record Appointment Outcome

- User can record the outcome for an appointment among the list that have happened.
- User can give prescription or MC to the patient.

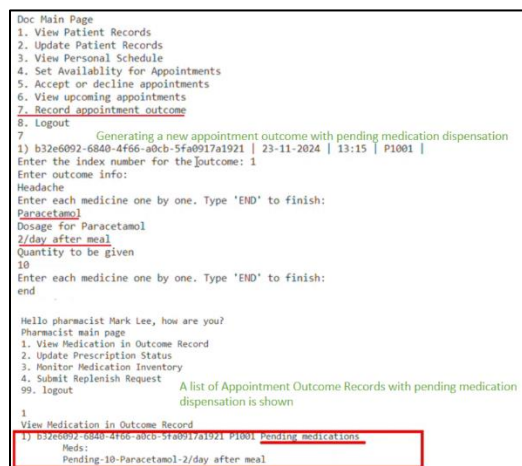


- The outcome is recorded to the database. The prescription is visible to the pharmacist; the MC is visible to the patient.

3.4. Pharmacist (Video Link)

1. View Appointment Outcome Record

- Pharmacists can select the “View Medication in Outcome Record” option from the menu.
- The system displays a list of Appointment Outcome Records with pending medication dispensation.



2. Update Prescription Status

- Pharmacists can select the “Update Prescription Status” option from the menu.

- The system displays a list of Appointment Outcome Records with pending medication dispensation.
- Pharmacists can select the index of an appointment from the list to dispense the medications.
- The prescription status is updated from “Pending medication” to “Completed”.
- Demonstration video link.

```

AppointmentOutcomeList
1 b32e6092-6840-4f66-a0cb-5fa0917a1921|23-11-2024|13:15|P1001|Headache|2:2/day after meal:10:false|pending medications|0001
2
An appointment outcome with "pending medication" dispensation.

Hello pharmacist Mark Lee, how are you?
Pharmacist main page
1. View Medication in Outcome Record
2. Update Prescription Status
3. Monitor Medication Inventory
4. Submit Replenish Request
99. Logout

2
Update Prescription Status
1) b32e6092-6840-4f66-a0cb-5fa0917a1921 P1001 Pending medications
Meds:
Pending-10-Paracetamol-2/day after meal
Enter index of appointment outcome to dispense
1
To prepare
1) Paracetamol - 10
Dispensed medication
Enter index of medication once dispensed
1
The prescription status is updated from "Pending medication" to
"Completed" once the medication is dispensed by a pharmacist.
AppointmentOutcomeList
1 b32e6092-6840-4f66-a0cb-5fa0917a1921|23-11-2024|13:15|P1001|Headache|2:2/day after meal:10:true|completed|0001
2

```

3. View Medication Inventory

- Pharmacists can select the “Monitor Medication Inventory” option from the menu.
- The system displays a list of medication, including stock levels and low-level alert.
- Demonstration video link.

```

Hello pharmacist Mark Lee, how are you?
Pharmacist main page
1. View Medication in Outcome Record
2. Update Prescription Status
3. Monitor Medication Inventory
4. Submit Replenish Request
99. Logout

3
Monitor Medication Inventory


|   | Name        | ID | Stock count | Alert At | Is Stock Low |
|---|-------------|----|-------------|----------|--------------|
| 0 | Ibuprofen   | 1  | 3087        | 500      | false        |
| 1 | Paracetamol | 2  | 266851      | 500      | false        |
| 2 | Amoxicillin | 3  | 75          | 15       | false        |


```

4. Submit Replenishment Request

- Pharmacists can select the “Submit Replenish Request” option from the menu.
- The system displays a list of medication.
- Pharmacists can select the index of a medication from the list to request replenishment.
- Request is subject to the administrator’s approval.

3.5. Administrator ([Video Link](#))

1. View and Manage Hospital Staff

- Administrator can select the “View/ Add/ Update/ Remove Staff” options from the menu.
- "View Staff" displays a list of staff members sorted by Name, Role, Gender, Age, or ID.
- For "Add Staff", the system prompts the administrator to input the role, ID, name, gender, and age of the new staff member.
- “Update Staff” allows the administrator to update a staff member’s information, such as their password or name.

- “Remove Staff” deletes the staff account from the Hospital Management System.

1 D001|p|John Smith|Doctor|Male|45
2 D002|password|Emily Clarke|Doctor|Female|38
3 P001|password|Mark Lee|Pharmacist|Male|29
4 A001|p|Sarah Lee|Administrator|Female|40
5 A002|p|Mummy Shark|Administrator|Female|40
6 D1|pw|Good Doctor|Doctor|Male|50
7 p1|Phar1|Pharmacist|Male|21
8 a1|Coco Melon|Administrator|Male|50
9

View Staff
Show order by
1) Name
2) Role
3) Gender
4) Age
5) Id
View staff list sorted by age

4
Order by age
ID Name Role Gender Age
p1 Phar1 Pharmacist Male 21
P001 Mark Lee Pharmacist Male 29
D002 Emily Clarke Doctor Female 38
A001 Sarah Lee Administrator Female 40
A002 Mummy Shark Administrator Female 40
D001 John Smith Doctor Male 45
D1 Good Doctor Doctor Male 50
a1 Coco Melon Administrator Male 50

2
Add Staff
Adding staff into the database
Select Role:
1. Doctor
2. Pharmacist
3. Administrator
Enter choice (1-3): 1
Enter new ID?
D003
Enter new Name?
Doctor3
Select Gender:
1. Male
2. Female
Enter choice (1-2): 2
Enter new Age?
65

Adding a new staff

1 D001|p|John Smith|Doctor|Male|45
2 D002|password|Emily Clarke|Doctor|Female|38
3 P001|password|Mark Lee|Pharmacist|Male|29
4 A001|p|Sarah Lee|Administrator|Female|40
5 A002|p|Mummy Shark|Administrator|Female|40
6 D1|pw|Good Doctor|Doctor|Male|50
7 p1|Phar1|Pharmacist|Male|21
8 a1|Coco Melon|Administrator|Male|50
9 D003|password|Doctor3|Doctor|Female|65

Show order by
1) Name
2) Role
3) Gender
4) Age
5) Id
New staff is reflected

4
Order by age
ID Name Role Gender Age
p1 Phar1 Pharmacist Male 21
P001 Mark Lee Pharmacist Male 29
D002 Emily Clarke Doctor Female 38
A001 Sarah Lee Administrator Female 40
A002 Mummy Shark Administrator Female 40
D001 John Smith Doctor Male 45
D1 Good Doctor Doctor Male 50
a1 Coco Melon Administrator Male 50
D003 Doctor3 Doctor Female 65

2. View Appointments Details

- Administrators can select the “View Appointment” option from the menu.
- A list of appointment history is displayed, including available, booked, and past appointment slot

1 0326002-0800-4756-4b5c-3f49974d2322|John Smith|20-11-2024|12:15|false|settled|P1001|D001
2 5c9f2f29-a74c-4222-bf16-6d221e3baaf|John Smith|20-11-2024|12:30|false|pending|P1002|D001
3 47f21169-71c9-45e8-9d8d-46d273dec21|John Smith|20-11-2024|12:00|true|available|NONE|D001
4

Please enter your password :
Login successful
Hello admin, Sarah Lee, how are you?
Administrator Main page
1. View Staff
2. Add Staff
3. Update Staff
4. Remove Staff
5. View Appointments
6. View Inventory
7. Change Alert Value
8. Approve Replenish Request
9. Reject Replenish Request
10. Add New Medication
11. Logout

View Appointments
Patient ID: P1001 Doctor ID: D001 Appointment Status: settled Datetime: 20-11-2024 12:15 Appointment not record: status: Pending medications Consultation notes: Headache
Patient ID: P1002 Doctor ID: D001 Appointment Status: pending Datetime: 20-11-2024 12:30 Appointment not record: 001
Patient ID: P1003 Doctor ID: D001 Appointment Status: available Datetime: 20-11-2024 12:00 Appointment not record: 001

3. View and Manage Medication Inventory

- Administrators can “View Inventory” and manage inventory by selecting “Change Alert Value” or “Add Medications” options from the menu.
- For “Change Alert Value,” the alert value can be adjusted so that low-stock medication triggers a notification.
- For “Add Medications,” any new medications can be added.

6
View Inventory
Name ID Stock count Alert At Is Stock Low
0 Ibuprofen 1 3087 500 false
1 Paracetamol 2 266861 500 false
2 Amoxicillin 3 175 15 false

Manage medication inventory by changing the alert value.
Before changing, the alert value is set to 15

Hello admin, Sarah Lee, how are you?
Administrator Main page
1. View Staff
2. Add Staff
3. Update Staff
4. Remove Staff
5. View Appointments
6. View Inventory
7. Change Alert Value
8. Approve Replenish Request
9. Reject Replenish Request
10. Add New Medication

7
Change Alert Value
1) Name: Ibuprofen Alert limit: 500
2) Name: Paracetamol Alert limit: 500
3) Name: Amoxicillin Alert limit: 15
Enter index of medication to change alert limit
3
Enter new alert limit
200
Alert limit have been changed.

The alert value is set to 200. The medication is now low stock

6
View Inventory
Name ID Stock count Alert At Is Stock Low
0 Ibuprofen 1 3087 500 false
1 Paracetamol 2 266861 500 false
2 Amoxicillin 3 175 200 true

4. Approve Replenishment Requests

- Administrators can select the “Approve Replenish Request” or “Reject Replenish Request” options from the menu.
- The system displays a list of replenish requests submitted by the pharmacist.

- Administrator can select the index of a replenishment request from the list to approve, and the stock level of the corresponding medication will be updated

```

Hello pharmacist Mark Lee, how are you?
Pharmacist main page
1. View Medication in Outcome Record
2. Update Prescription Status
3. Monitor Medication Inventory
4. Submit Replenish Request
99. Logout
      Stock count before the replenish request is approved

3
Monitor Medication Inventory
+-----+-----+-----+-----+-----+
| Name      | ID   | Stock count | Alert At | Is Stock Low |
+-----+-----+-----+-----+-----+
| 0 | Ibuprofen | 1 | 3887 | 500 | false |
| 1 | Paracetamol | 2 | 266851 | 500 | false |
| 2 | Amoxicillin | 3 | 75 | 15 | false |
+-----+-----+-----+-----+-----+

Hello admin, Sarah Lee, how are you?
Administrator Main page
1. View Staff
2. Add Staff
3. Update Staff
4. Remove Staff
5. View Appointments
6. View Inventory
7. Change Alert Value
8. Approve Replenish Request
9. Reject Replenish Request
99. Logout

8
Approve Replenish Request
1) Replenish request for 1 Paracetamol
2) Replenish request for 3 Ibuprofen
3) Replenish request for 5 Ibuprofen
4) Replenish request for 100 Amoxicillin
Enter index of replenish request to approve
Enter 'END' to exit.
4
Replenish request is APPROVED.
      Stock count is updated accordingly after the replenish request is approved

6
View Inventory
+-----+-----+-----+-----+-----+
| Name      | ID   | Stock count | Alert At | Is Stock Low |
+-----+-----+-----+-----+-----+
| 0 | Ibuprofen | 1 | 3887 | 500 | false |
| 1 | Paracetamol | 2 | 266861 | 500 | false |
| 2 | Amoxicillin | 3 | 175 | 15 | false |
+-----+-----+-----+-----+-----+

```

4. Reflection

The assignment has given us the chance to apply the design principles, which further enhance our understanding of the principles and their importance in designing good systems. At first, it was difficult to figure out the number and the types of entities needed for the system. However, after referring to the principles, we were able to design a system that can offer more automation in hospital operations. Additionally, as the system was run and tested, we discovered some minor inconveniences that can be improved for better user experience. Thus, we further implemented small changes to the system, for example, providing clearer appointments status labels or letting users choose appointment slots by indexing. This made us recognize that it is important to carefully take the users into consideration when designing programs as well as systems, and that with just small manipulations, we can make the system much more user-friendly. Besides improving user experience, we also realize the need for practicality in the system, which explains why we have chosen to implement several useful but simple enough features mentioned above.

Link to project

Link: <https://github.com/Caven-Chew/HMS/>