



Virtual Health Helper: A web application

Project in Computer Engineering

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Contents

1. Project.....	3
1.1. Objective	3
1.2. Problem Statement.....	3
1.3. Solution	3
1.4. Market	3
2. Description	5
2.1. Project Description.....	5
2.1.1. Doctors.....	5
2.1.2. Patients.....	5
2.2. User Flow.....	5
2.3. Implementation of the ontology	6
3. Use Cases	7
3.1. Use Case Diagram.....	7
3.2. Use Case tables.....	7
4. Activity Diagram.....	11
4.1. Ask Questions.....	11
4.2. Make an appointment.....	12
4.3. Order OTC Drugs	13
4.4. Consult Appointments.....	14
4.5. Answer Questions.....	15
5. Class Diagram.....	16
6. System Architecture	17
7. Conclusion	18

1. Project

1.1.Objective

The objective of the project is to create a thorough and clear analysis of the user requirements and the project design by using UML (Unified Modeling Language). Furthermore, this enables us to learn more about the analysis phase of project development.

Part of my thesis, the ontology driven edition of decision trees, is included in this project, to work towards an industrial implementation of my research.

1.2.Problem Statement

Medical diagnosis is defined as observation of symptoms to deduce probability of a condition or a disease. The quality of diagnosis is typically supplemented by patient medical history, profile, examination and tests as necessary. The process of a traditional patient-doctor interaction in an institution like hospital or clinic has the following challenges.

From a patient point of view,

- Hassle of getting a date of physical appointment
- Have to travel to the clinic or hospital
- Risk of being around other patients in enclosed room

From a doctor point of view,

- Can attend lesser number of patients in a particular span of time
- Only encounters patients coming from a particular neighborhood of the clinic
- Have to use same degree of diagnosis for patients with generic symptoms that can be treated without visual assessment
- Risk of being in close proximity with patient having contagious disease like pandemic situation now

From a hospital or clinic point of view,

- Overcrowding in a physical space
- Increase in workload for medical experts

1.3.Solution

In this project keeping an alignment with my thesis, I propose an idea of a chatbot.

This Bot is a Two-way application for General physicians and patients. The patient / medical expert can enter symptoms and the algorithm will return the most likely disease/disorder the patient is suffering from and eliminates all of the above issues.

1.4.Market

According to the health consumer survey, 2017, by Accenture, 70% of all the consumers are willing to experience health care services virtually, apart from this only 20% have experienced virtual healthcare.

(Source: <https://straitresearch.com/report/online-doctor-consultation-market>)

Physicians and other health professionals are now seeing 50 to 175 times the number of patients via telehealth than they did before the pandemic. The report notes that 46% of patients are now using telehealth to replace canceled

in-person visits, up from the just 11% of patients who used telehealth in 2019. According to Mckinsey's report the during the covid time the surge in healthcare increased from 11 percent use to 76 percent which has been driven by the immediate action to avoid exposure to COVID 19. More than 70 percent in person visits cancelled.

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(Source : <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality#>)

2. Description

2.1. Project Description

The project will be a healthcare platform for patients and doctors alike. Doctors will be able to join the platform as healthcare professionals, patients will be able to join the platform to ask medical questions, to book appointments and to order OTC drugs.

2.1.1. Doctors

Each doctor will have one or more specializations, these specializations will be used by the platform to redirect patients, when searching for a specific type of doctor. There is also an "Answer questions" section on the platform, which is divided in categories. Patients will be able to ask any medical question here, and it will be directed to doctors who have the specialization that the question is about.

Doctors will also have an integrated calendar on the platform, they will be able to consult and manage their appointments here.

2.1.2. Patients

Patients can register on the platform to do a multitude of things. First of all, they are able to book appointments with all linked doctors on the platform. They can search for specialized doctors, depending on their needs.

Patients are also able to ask medical questions to experts. All they have to do is post a question, and the specific category the question belongs to. A doctor who specializes in that field, can then see the question and give an answer to the patient.

Lastly, patients are able to order OTC (over the counter) drugs, from the platform. There is an online web shop available within the platform, where patients can order drugs that do not require a prescription. This is so patients do not have to go to an apothecary when feeling ill or if a doctor suggests taking a certain type of medicine in the "Asking Questions" section, you can easily order it from the platform.

2.2. User Flow

Each flow will depend on what user is logging in and what their purpose is.

Doctor flow:

- Log in
- Navigate to Answer Questions section
 - Read unanswered questions
 - Answer questions with information/recommendations
 - Reply to a patient's follow up
- Navigate to Calendar
 - Consult appointment
 - Look at schedule
 - Manage an appointment

Patient flow

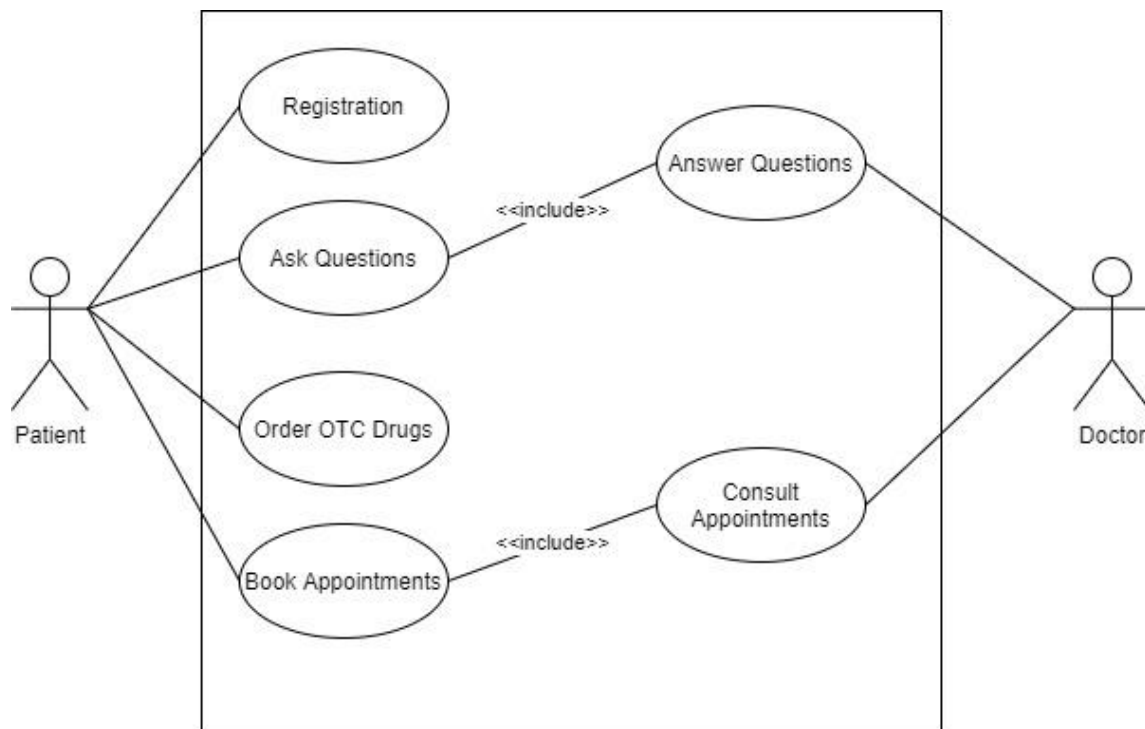
- Register to platform
- Login
 - Navigate to Appointments
 - Consult previous appointment
 - Book a new appointment
 - Navigate to web shop
 - Search for specific/recommended drug
 - Add to basket
 - Choose delivery address
 - Choose payment method
 - Complete order
 - Navigate to Ask questions section
 - Submit question & choose the correct category
 - Continue a previous thread to follow up with a doctor

2.3. Implementation of the ontology driven edition of Decision Tree.

When the patient enters one or more particular symptoms which can be cured or aided by OTC drugs, the ontology properties will be playing a role for suggesting a particular drug. In this case the output of the Decision Tree algorithm will be taken into consideration. The symptoms will have a relation to the OTC drug. A splitting rule based on Pearson's correlation Coefficient can be taken into consideration to generate partitions in each node and proceed with the Decision Tree algorithm before implementing ontology properties.

3. Use Cases

3.1. Use Case Diagram



3.2. Use Case tables

Use Case Name	As a patient I would like to be able to ask questions to a doctor.
Actors	<ul style="list-style-type: none">• Patient
Pre-conditions	<ul style="list-style-type: none">• The patient has the app installed.• The patient is logged into the system.• The patient has the correct "Patient" role assigned.
Flow	<ol style="list-style-type: none">I. The patient navigates to the "Ask Questions" platform.II. The patient chooses a category for their question.III. The patient enters their question for the doctor.
Alternate	<ol style="list-style-type: none">III. The patient will check the FAQ of the category.IV. The patient finds the answer within the FAQ. (If not they continue to ask the question for the doctor)
Exceptions	<ul style="list-style-type: none">➔ The patient does not choose the correct category for their question.➔ The patient doesn't know what category their question belongs in.
Post-conditions	<ul style="list-style-type: none">• The question of the patient is posted to the correct group of doctors, this can be general, or if it is specific to a certain category. (Teeth -> dentists, skin -> dermatologist etc.)

Use Case Name	As a patient I would like to be able to make an appointment with a doctor
Actors	<ul style="list-style-type: none"> • Patient
Pre-condition	<ul style="list-style-type: none"> • The patient has the app installed. • The patient is logged into the system. • The patient has the correct "Patient" role assigned.
Flow	<ol style="list-style-type: none"> The patient navigates to the "Make an appointment" section The patient picks a doctor to make an appointment with. The patient can choose one of the free timeslots for the chosen doctor. The patient confirms the appointment The patient will receive a confirmation mail by the system with the date, time & reason for the appointment.
Alternate	<ol style="list-style-type: none"> The patient followed the "make an appointment" link from a doctor's answer, after asking a question. (afterwards continues from step 2)
Exceptions	<ul style="list-style-type: none"> ➔ The patient tries to book an appointment on a booked slot. ➔ The patient makes an appointment with the wrong doctor.
Post-conditions	<ul style="list-style-type: none"> • An appointment is made for the patient, with the chosen doctor. The appointment will be booked in the doctor's calendar, and the patient has received a confirmation.

Use Case Name	As a patient I would to be able to order OTC (Over the Counter) drugs from the platform's web shop.
Actors	<ul style="list-style-type: none"> • Patient
Pre-condition	<ul style="list-style-type: none"> • The patient has the app installed. • The patient is logged into the system. • The patient has the correct "Patient" role assigned.
Flow	<ol style="list-style-type: none"> The patient navigates to the web shop on the platform. The patient searches for the drug he/she is looking for. The patient adds the drug to his/her shopping basket. The patient continues to checkout. The patient enters personal & address details. The patient chooses payment method. The patient follows payment instructions. The patient receives an order confirmation mail.

Alternate	IV. The patient continues to search for more products to add to his/her basket, after which he/she continues to Step IV (Checkout).
Exceptions	<ul style="list-style-type: none"> ➔ The web shop doesn't have the drug the patient is looking for. ➔ The Patient doesn't have enough money on his/her account, which causes the payment to fail. ➔ There is an error with the banking API, which causes the payment to fail
Post-conditions	<ul style="list-style-type: none"> • The patient has received an order confirmation mail. • The patient's bank balance went down with the amount of the order. • The web shop will pack and ship the drugs as soon as possible.

Use Case Name	As a patient I would like to be able to register.
Actors	<ul style="list-style-type: none"> • Patient
Pre-condition	<ul style="list-style-type: none"> • The patient has the app installed. • The patient does not have an account on the app.
Flow	<ol style="list-style-type: none"> I. The patient opens the app. II. The patient clicks the "register" button. III. The patient enters his/her personal details. IV. The patient clicks "Create account"
Alternate	<ol style="list-style-type: none"> I. The patient tries to log in with his/her email address. II. The patient is informed they have no existing account yet. III. The patient clicks the "register now" button. (Continue to step III)
Exceptions	<ul style="list-style-type: none"> ➔ The patient already has an existing account with his/her email address. ➔ The Patient's password is not secure enough.
Post-conditions	<ul style="list-style-type: none"> • The patient has received an account creation confirmation mail. • The patient's account is added to the App's database.

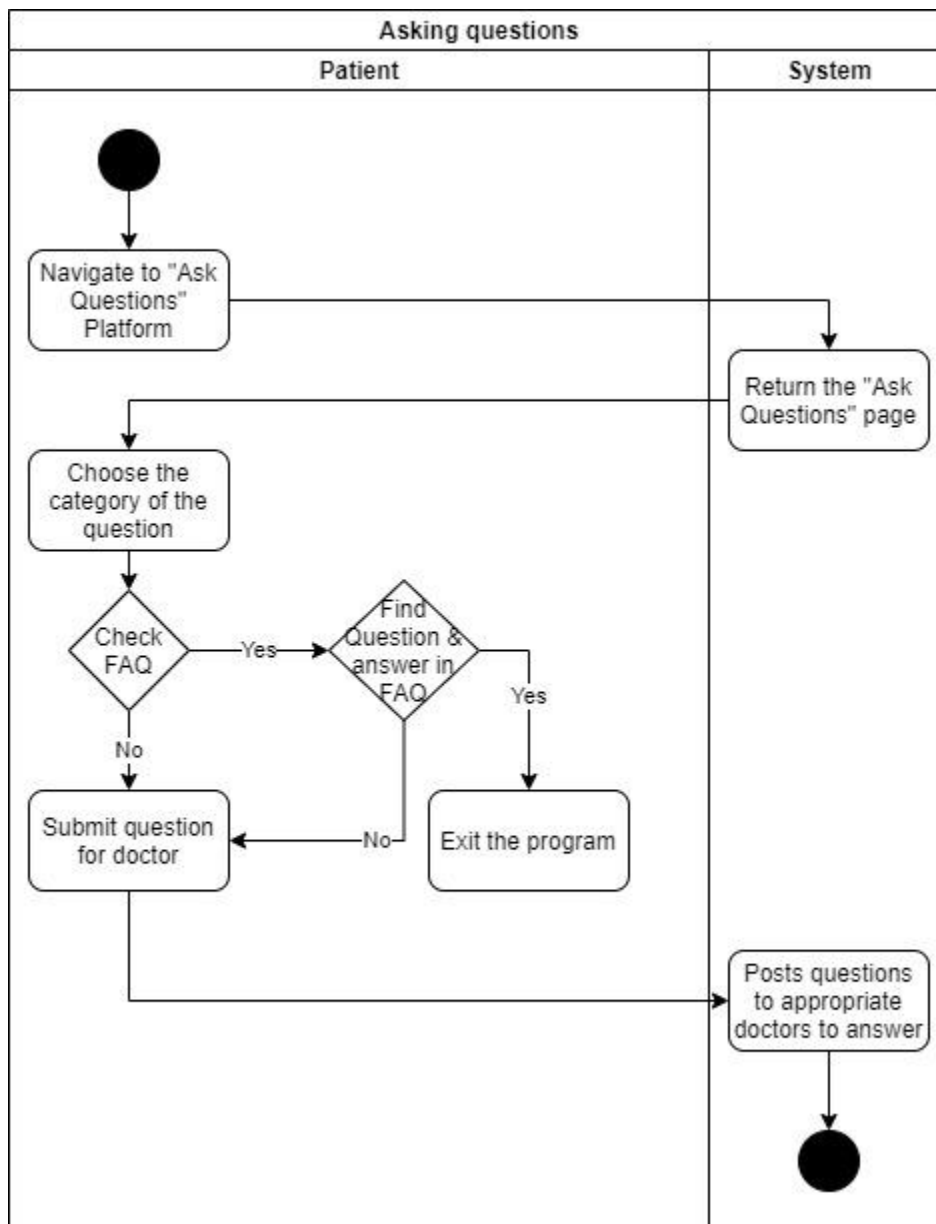
Use Case Name	As a doctor I would like to be able to consult the appointments in my agenda.
Actors	<ul style="list-style-type: none"> • Doctor
Pre-condition	<ul style="list-style-type: none"> • The doctor has the app installed. • The doctor is logged into the system. • The doctor has the correct "Doctor" role assigned. • The doctor has one or more appointments booked with patients.
Flow	<ol style="list-style-type: none"> I. The Doctor navigates to his/her agenda. II. The doctor will be able to view all of his/her appointments for the day/week/month.

	III. The doctor selects the appointment he/she wants to consult IV. The page will show the doctor all appoint information (Date, time, patient, complaint, patient history, etc.)
Alternate	/
Exceptions	➔ The doctor consults the wrong appointment ➔ The doctor doesn't have the correct role
Post-conditions	• The doctor has all the information about the specific appointment

Use Case Name	As a doctor I would like to be able to answer patient's questions
Actors	• Doctor • Patient
Pre-condition	• The doctor has the app installed. • The doctor is logged into the system. • The doctor has the correct "Doctor" role assigned. • The doctor is assigned to one or more question categories. • There are one or more questions in the categories the doctor is assigned to.
Flow	I. The doctor navigates to the Questions platform II. The doctor picks an unanswered question III. The doctor answers the patient's question. IV. A notification will be sent to the patient about the doctor's reply.
Alternate	II. The doctor realizes the question is in the wrong category and moves it to the correct category. III. A (different) doctor continues to answer the patient's question.
Exceptions	➔ The Doctor doesn't understand the patient's question and can ask for a clarification. ➔ The doctor doesn't have the correct role assigned and can't see any questions
Post-conditions	• The patient has received a notification of the doctor's response, and can communicate with this doctor, or continue to book an appointment if deemed necessary.

4. Activity Diagram

4.1. Ask Questions

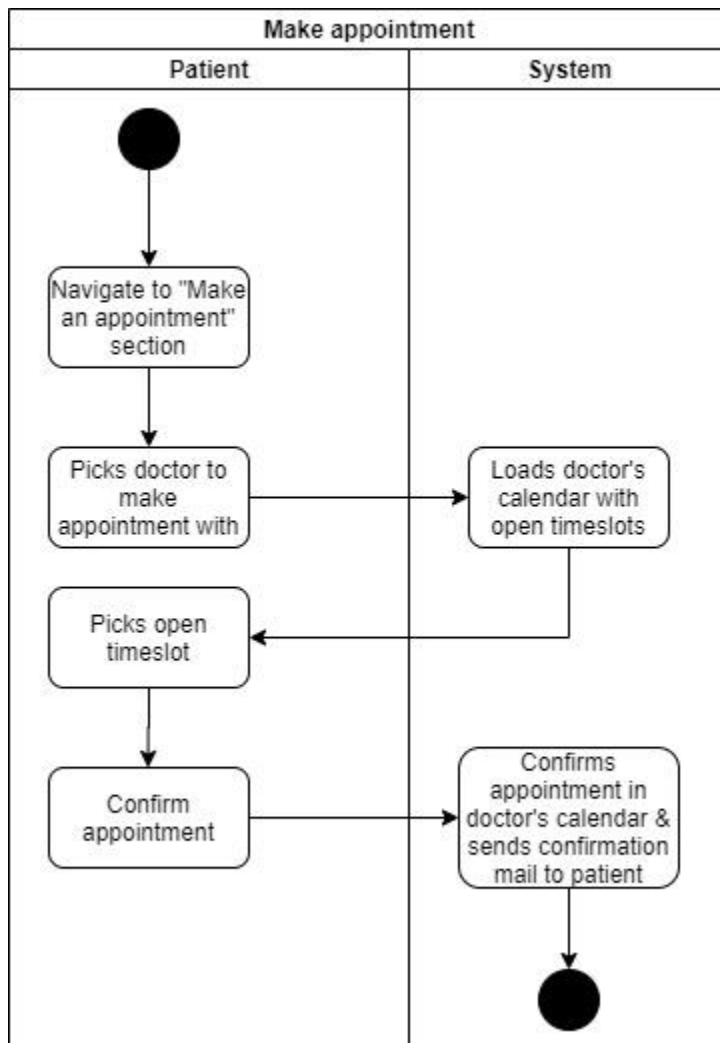


This activity describes the patient asking a question in the "Ask Questions" section. Before this activity can happen, the patient is required to already have an account on the platform and be logged in.

Once the patient navigates to the ask questions section, he/she can choose a category for the question. Here, some common questions with answers will be listed. If the patient can find his/her question here, they can read the answer and exit. If not, they will be able to type out a question and submit it.

If a doctor has replied to a question the patient has the opportunity to follow up with the doctor and book an appointment if deemed necessary.

4.2. Make an appointment

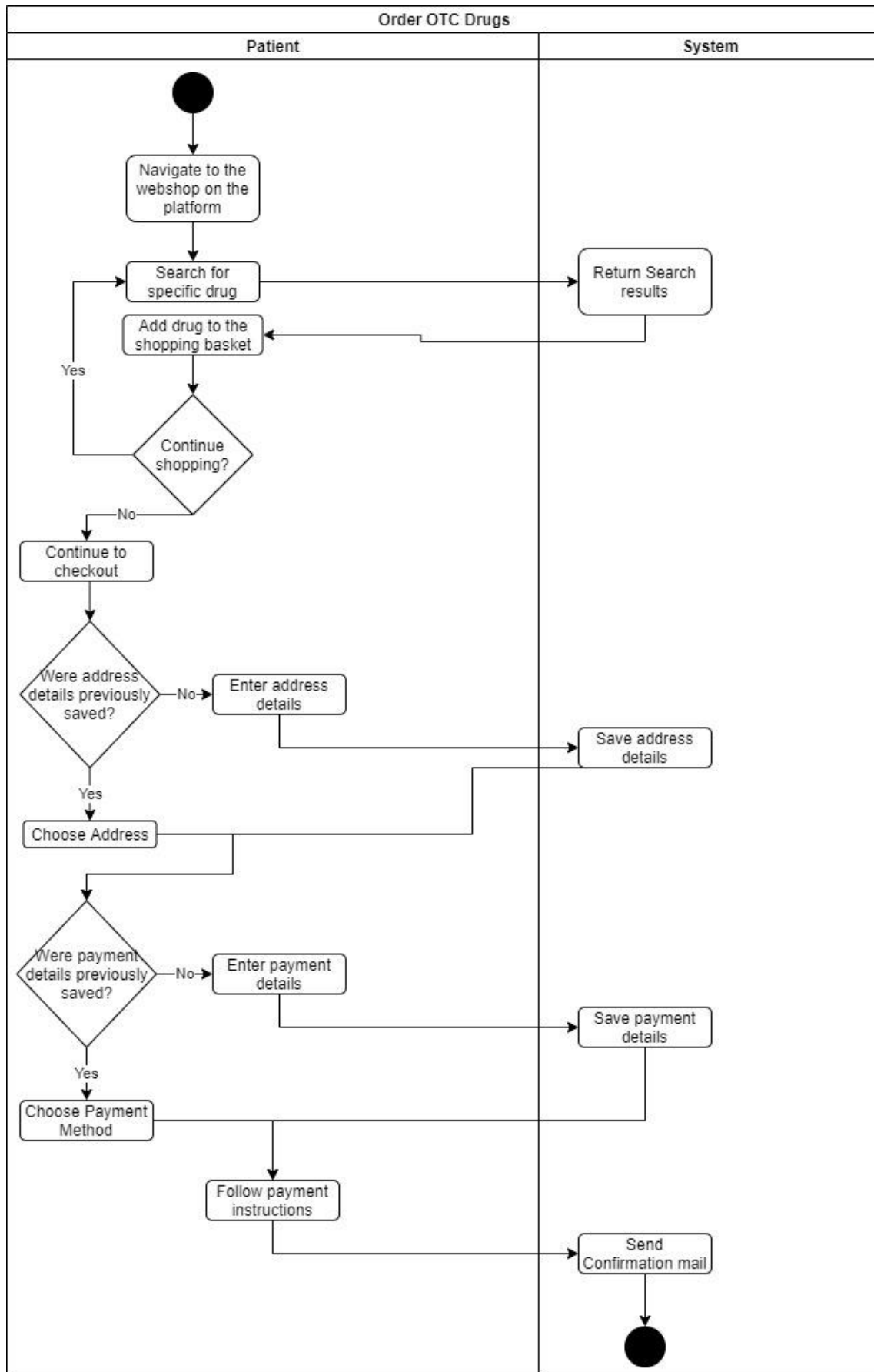


This activity describes the patient making an appointment. Before this activity can happen, the patient is required to already have an account on the platform and be logged in.

Once the patient navigates to the book appointment section, he/she is able to search for doctors in his/her area, search a doctor by name or search by specialization. Once the patient has found a doctor to book an appointment with, he/she can view their schedule and open timeslots.

Once the patient has picked a slot and booked the appointment, a confirmation mail will be send to the patient, and the slot will get booked in the doctor's calendar.

4.3. Order OTC Drugs

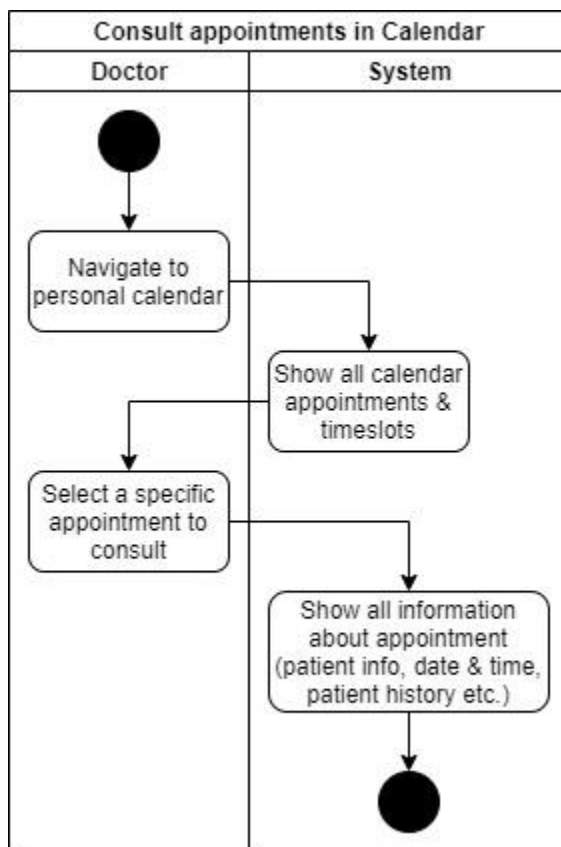


This activity describes the patient ordering OTC drugs from the web shop. Before this activity can happen, the patient is required to already have an account on the platform and be logged in.

Once the patient navigates to the web shop, he/she can search a specific product by name or search for products by category. Once a product is found the patient can add it to their shopping basket. After which the patient can continue searching and adding products.

When the patient is done "shopping", he/she can continue to checkout. Here the patient can choose the delivery address and payment method. Once chosen, he/she has to follow the payment instructions. Once the order is completed, the patient will receive an order confirmation mail, and the order will be processed.

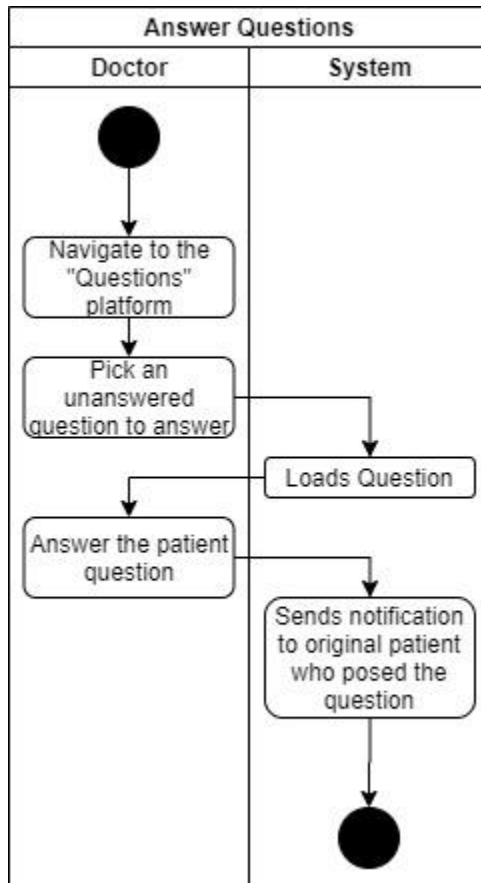
4.4. Consult Appointments



This activity describes the doctor wanting to consult an appointment in his/her calendar. Before this activity can happen, the doctor is required to be registered on the platform and be logged in.

Once the doctor navigates to his/her calendar, he/she can choose the appointment to consult. All of the information of the appointment will be displayed. The doctor can also see which patient booked the appointment and he/she can access his/her medical history.

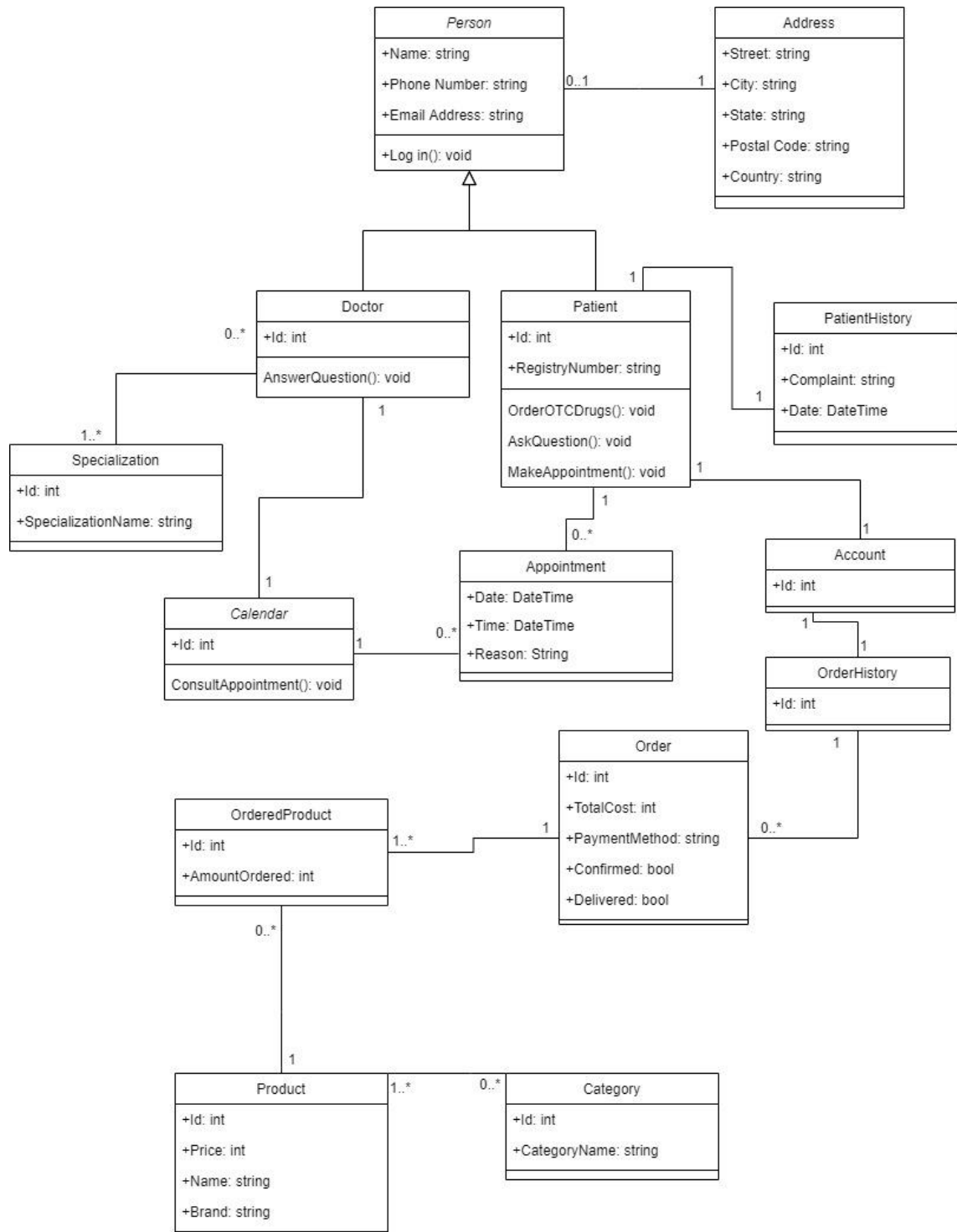
4.5. Answer Questions



This activity describes the doctor wanting answer a question in the answer questions section. Before this activity can happen, the doctor is required to be registered on the platform and be logged in.

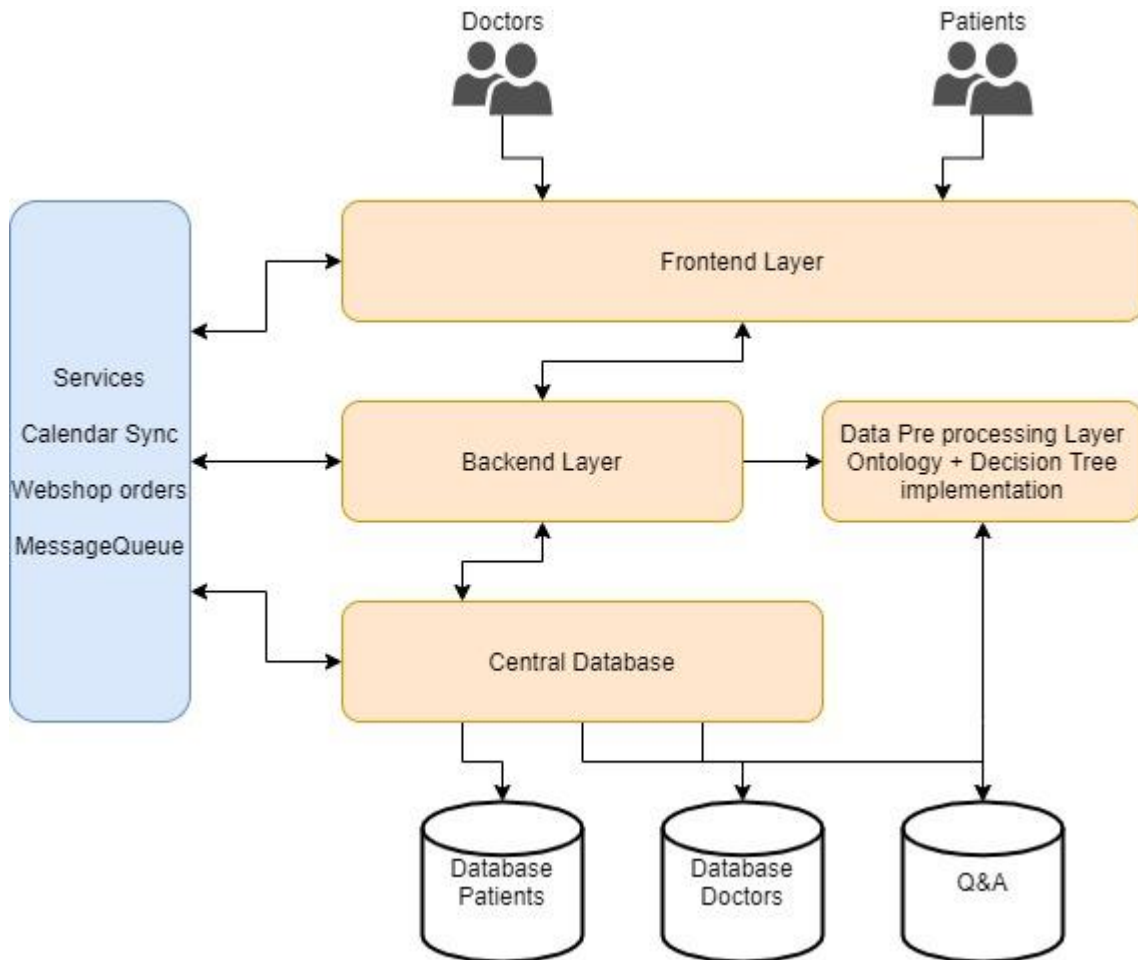
Once the doctor to the answer questions section, he/she can view all of the posted questions, regarding his/her specialization. Previously posted questions already answered by the doctor that have gotten a follow up from the patient will also be visible here. The doctor can then navigate to a question, to give their professional opinion/consultation on the matter. The patient will be notified on the platform if a doctor has replied to their question.

5. Class Diagram



The above class diagram describes the entities that are currently necessary for the application. The bottom part of the diagram mainly relates to the web shop, and the top part to the doctor & patient interactions.

6. System Architecture



The **Frontend layer** will be developed in React.js. React is a JavaScript library for building user interfaces, web-based applications, and responsive websites.

The **backend layer** will be constructed in Python and the Django framework to develop the webapp.

Python will be the programming language for the health care app, because the framework allows for secure exchange of information with other solutions. This is important for the web application considering the fact that the database should be highly privatized and secure. It also allows to analyze larger sets of data using machine learning algorithms to get a meaningful insight and proceed in right direction.

Django It is a high-level python web framework for rapid development of secure and maintainable websites. Django follows a model- view-controller architecture pattern.

The **databases** will be SQL Server databases.

7. Conclusion:

The project leaves a lot of room for expansion in various areas, such as: video consultation, Identity login, Online prescriptions & ordering prescribed drugs from the web shop. Another interesting feature will be chatbot. All the data generated from questions and answers can be used to create a AI-oriented chatbot once there is enough data. This will leave the doctors with more time to treat patients because the chatbot can take over most of the questions. These features would help the application quickly jump to a higher level in the market.