MŰEGYETEM 1782

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PhysioHub and PhysioLink

Companion Android Apps for Physiotherapists and their Patients

Project Laboratory

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BUDAPEST, 2024

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STUDENT DECLARATION

I, **Jena Woodroffe**, the undersigned, hereby declare that the present BSc Project Laboratory work has been prepared by myself and without any unauthorized help or assistance. Only the specified sources (references, tools, etc.) were used. All parts taken from other sources word by word, or after rephrasing but with identical meaning, were unambiguously identified with explicit reference to the sources utilized.

Budapest, 27 May 2024

....

Jena Woodroffe

Summary

This project was created to serve the needs of physiotherapists and their patients. After attending physiotherapy for many years, I realised how archaic and disorganised physiotherapy can be in terms of communication, data sharing etc. The apps were created to create structure and formality in the communication between physiotherapists and patients.

This meant that the applications needed to achieve various functions. Firstly, designated communication was very important. Many physiotherapists run their practice through their personal devices, meaning that using a simple texting platform to communicate with patients results in physiotherapists struggling to separate their personal and work lives. By communicating solely through a designated application, it allows physiotherapists to turn off just that application and be able to fully relax during time off.

Secondly, the applications need to be able to store and manage all of the data related to physiotherapy. This includes exercises that are assigned to specific patients with instructions that the physiotherapists can create and manage and the patients can view.

Finally, I wanted the application to include a calendar functionality where physiotherapists can manage their appointments and their schedule. This appointments are also shared with the respective patients.

Introduction

1. Project background and description

These two android applications are created with the goal of connecting physiotherapists (PTs) with their patients in a seamless and well structured manner. The primary application, PhysioHub, is for the PTs to use and allows them to create, view, manage and update exercises for each patient, as well as create new appointments in their calendar and message their patients. The companion application, PhysioLink, is for the patients to log in and use. They can view the exercises assigned to them by their PT and message them on the application.

2. Project scope

Functions worked on this semester:

1. Refactoring the base starting project to properly align with the MVC (Model-View-Controller) design pattern
2. Creating distinct, mutually exclusive log-in systems for each of the applications
3. Invitation system to invite patients and link their information with their PT's
4. Exercises functionality in both applications – filtering, viewing, management, creation
5. Chat functionality between the applications

Technologies used

1. Front end and logic

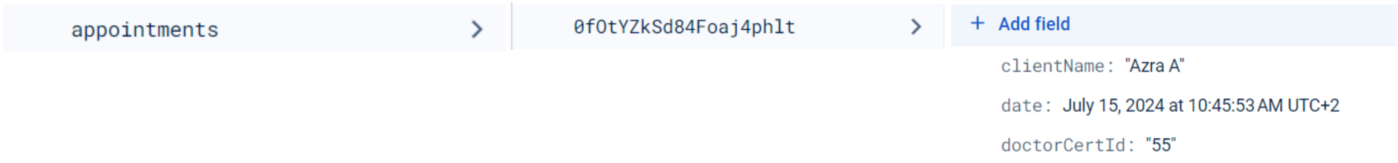
- Class logic and front-end design is made through the Android Studio IDE
- Classes are coded in Kotlin
- UI is all made using XML to provide the initial layout and then dynamically adapted in the Kotlin classes
- Both Fragments and Activities are used to allow the users to seamlessly change between functionalities

2. Back end and data storage

- The back-end logic is implemented with Firebase and its tools
- Authentication is handled by Firebase Authentication – using both their Google Sign-In tool and their Email and Password Sign-in option.
- All information related to PTs and their patients – including invitations, appointments, exercises and messages – is stored in Firebase Firestore.
- All data is retrieved, edited and created through the relevant Data Access class.

Firebase examples:

Appointments Collection



appointments >

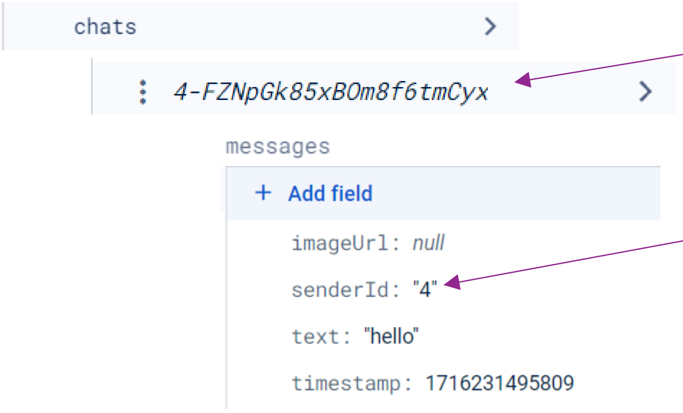
0f0tYZkSd84Foaj4phlt >

clientName: "Azra A"

date: July 15, 2024 at 10:45:53 AM UTC+2

doctorCertId: "55"

Chats Collection



chats >

4-FZNpGk85xBOm8f6tmCyx >

messages

imageUrl: null

senderId: "4"

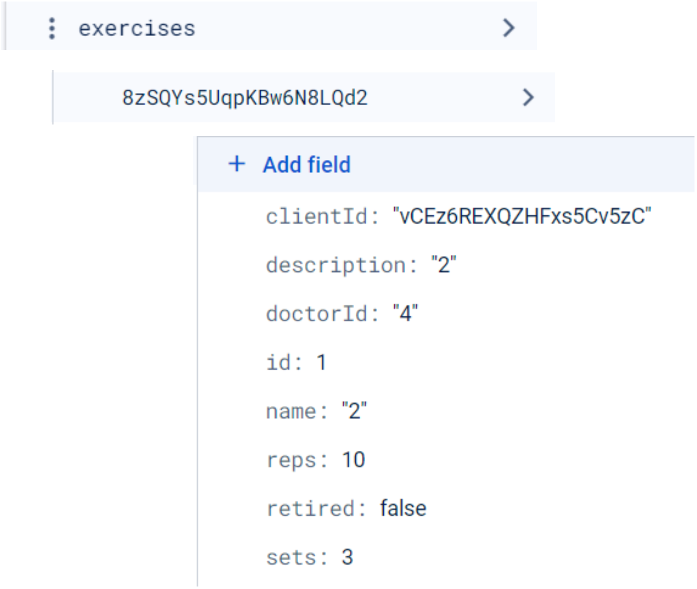
text: "hello"

timestamp: 1716231495809

Chat ID's are formatted as (PT's ID-Patient's ID) to connect the patients with their PTs

senderId is used to identify if a message is being received or sent from the user

Exercises Collection

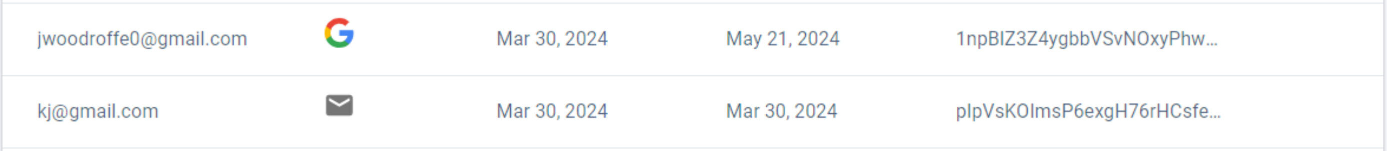


exercises

8zSQYs5UqpKBw6N8LQd2

```
clientId: "vCEz6REXQZHFxs5Cv5zC"
description: "2"
doctorId: "4"
id: 1
name: "2"
reps: 10
retired: false
sets: 3
```

Firebase Authentication



jwoodroffe0@gmail.com	G	Mar 30, 2024	May 21, 2024	1npBIZ3Z4ygbbVSvNOxyPhw...
kj@gmail.com	✉	Mar 30, 2024	Mar 30, 2024	plpVsKOImsP6exgH76rHCsfe...

Since I needed to use the Firebase Authentication within a single Firebase project, I utilised different Firebase login tools to ensure that patients registered to the PhysioLink (patients app) cannot access the PTs app. I used email and password login for the patient’s app and Google Sign-in for the doctors app.

Project Structure

I used the Model-View-Controller design pattern for this project and the structure is built in a way to support that. I have listed the design of only one application, but since the second application is just a derivative of this one with less functionality, the structure is almost identical.

PhysioHub (PTs' App)

model

Contains the data models representing the structure of data used in the app

Appoitment
ClientModel - *clients refer to patients*
DoctorModel - *doctors refer to physiotherapists*
ExerciseModel
MessageModel

data

Manages data access and operations, including database queries and network requests

AppointmentDataAccess
ChatDataAccess
ClientDataAccess
DoctorDataAccess
ExerciseDataAccess
DoctorDataHolder – *holds the data of the currently logged in PT*

utils

Provides utility classes

NoteSharedPreferencesHelper

adapter

Acts as controllers to manage complex activities by handling the logic connecting data models to the views.

ExerciseAdapter
ExerciseAdapterListener
ExerciseViewHolder
MessageAdapter
SearchClientRecyclerAdapter

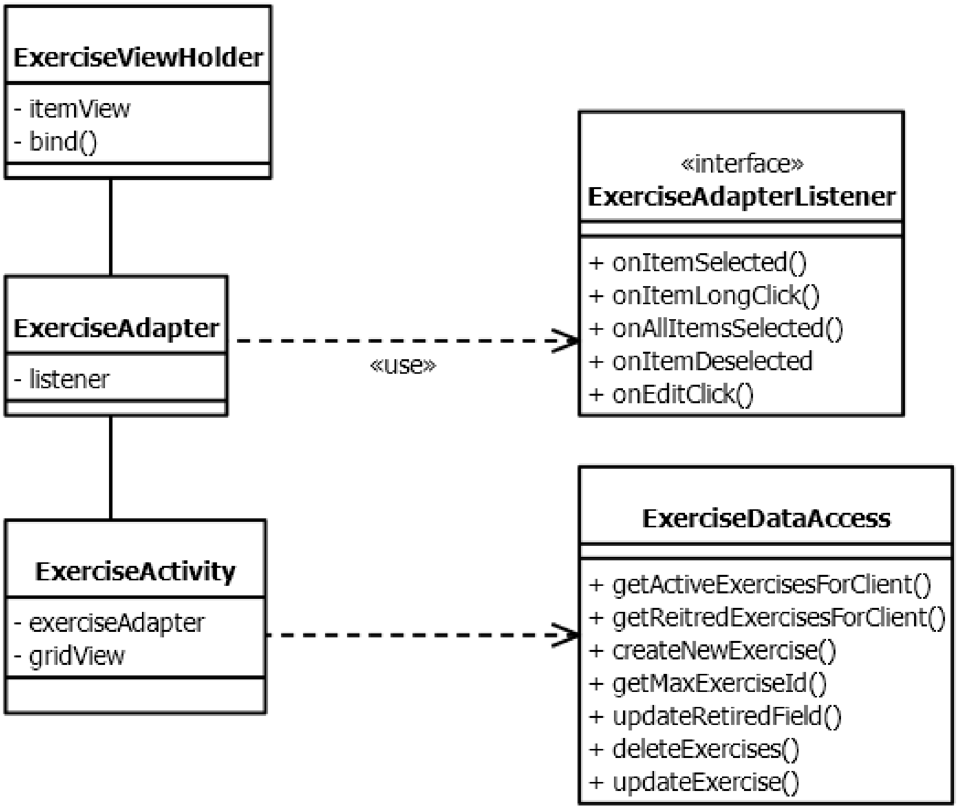
activities

- *Many activities are created in this application – for logging in, registering, viewing clients, inviting new clients, messaging clients, viewing, editing and create exercises, viewing information about the client as well as for viewing and creating new appointments.*

Architecture Overview

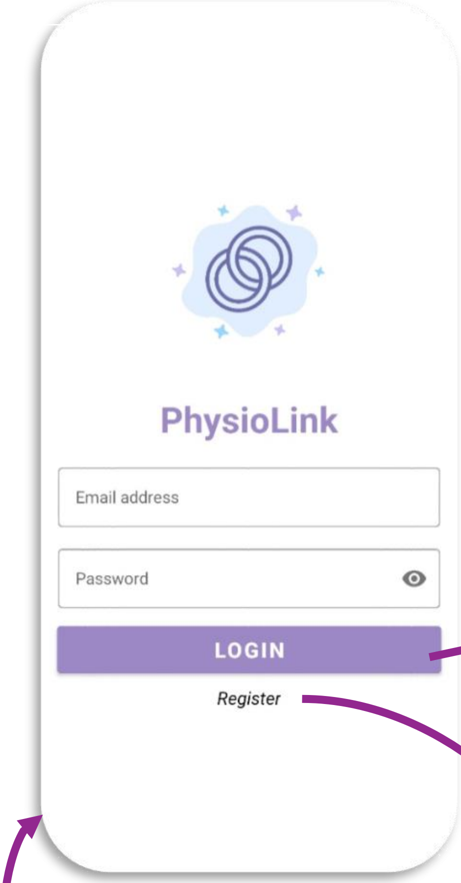
The functionalities created in these applications follow the rules of MVC design. The following description describes the architecture used to implement the Exercises functionality.

In this Android application, *ExerciseActivity* serves as the view, managing the user interface and interacting with *ExerciseAdapter* to display exercise items. *ExerciseAdapter*, functioning as a controller, binds the exercise data to the UI components managed by *ExerciseViewHolder* and handles user interactions such as clicks, edit clicks and long clicks. The *ExerciseAdapterListener* interface defines callbacks for these interactions, ensuring they are communicated back to the activity. Data operations are handled by *ExerciseDataAccess*, which *ExerciseActivity* relies on to retrieve and manipulate exercise data, maintaining a clear separation of concerns within the MVC pattern.



Results – PhysioLink (Patients' app)

Login

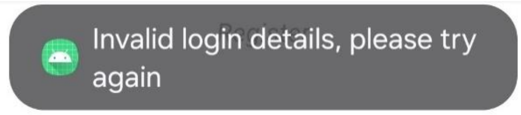


Patient registration flow:

Navigation is easily allowed using the back icon in the top left of each screen.

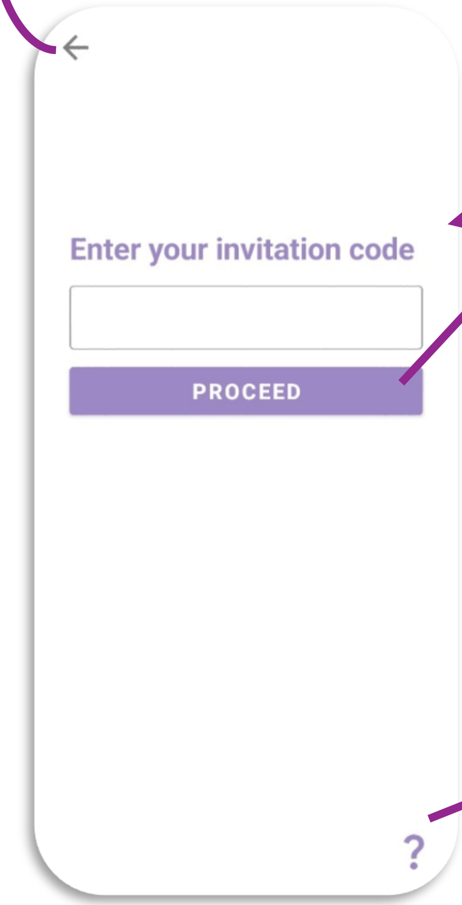
Logic of the invitations: Invitations are generated and emailed to patients. The invitation includes the PT's ID and a timestamp for expiration of the code (after which it cannot be used).

Toast made when no user is returned from the authentication

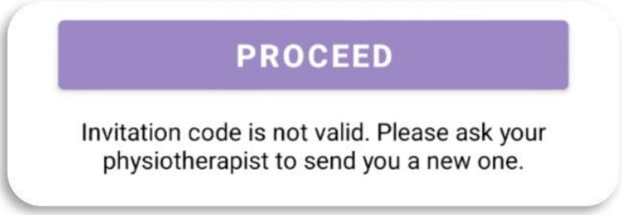


Invalid login details, please try again

Registration – Invitation Code

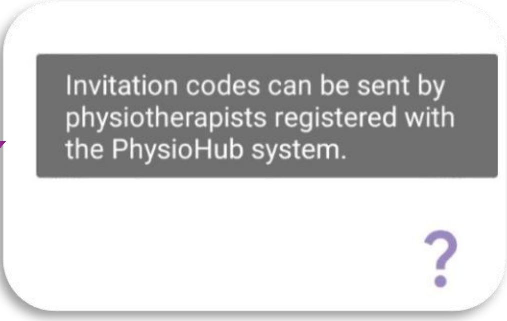


Incorrect invitation code (invitation code doesn't exist in the database/ has expired)



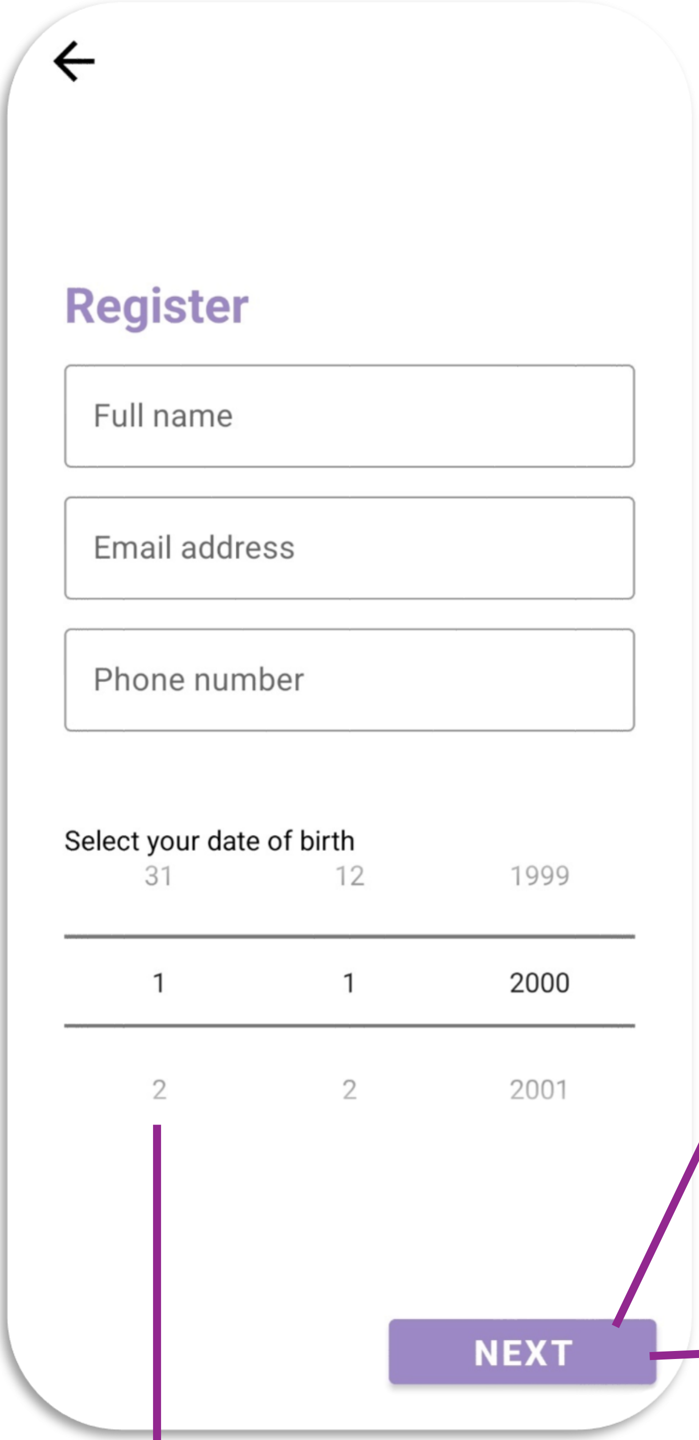
Invitation code is not valid. Please ask your physiotherapist to send you a new one.

Correct invitation code: proceeds to registration (shown on next page)



Invitation codes can be sent by physiotherapists registered with the PhysioHub system.

__Registration – Patient Details__



Register

Full name

Email address

Phone number

Select your date of birth

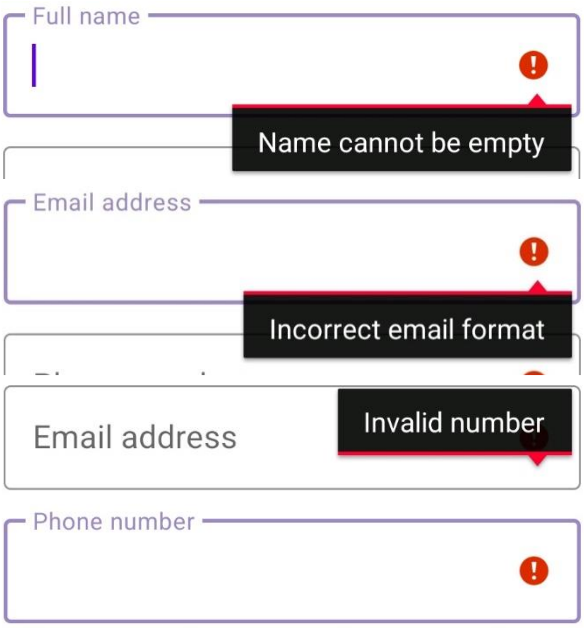
31 12 1999

1 1 2000

2 2 2001

User input validation:

- Name is checked as not null and only letters
- Email format is checked using Regex
- Number is checked to have 10 digits



Full name

Name cannot be empty

Email address

Incorrect email format

Email address

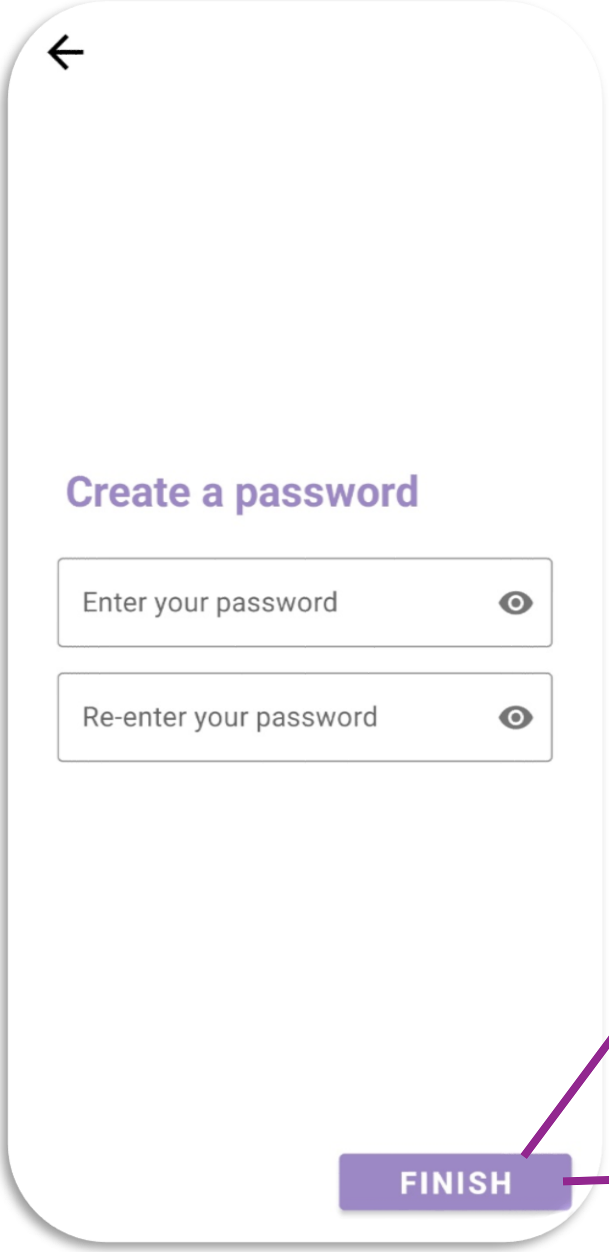
Invalid number

Phone number

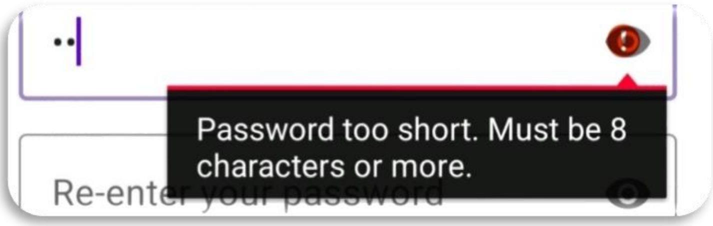
With valid input:
User progresses to password activity shown on the next page

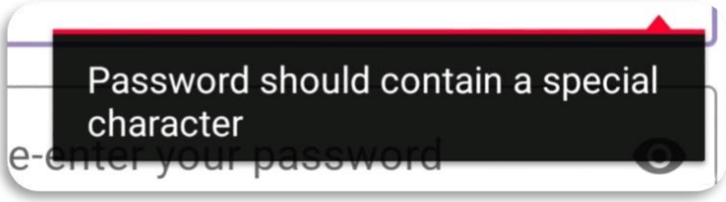
Date of birth NumberPicker
I used three NumberPickers for day, month and year. The maximum year is the current year.

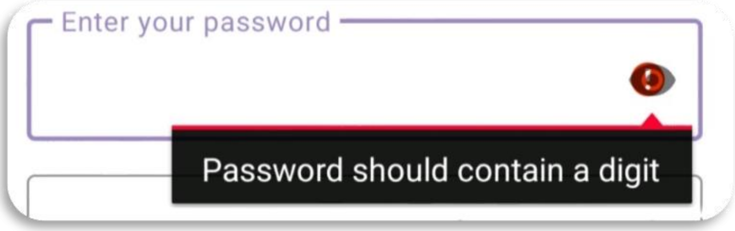
Registration – Password



Password validation:
Also checks if passwords match each other


Password too short. Must be 8 characters or more.


Password should contain a special character

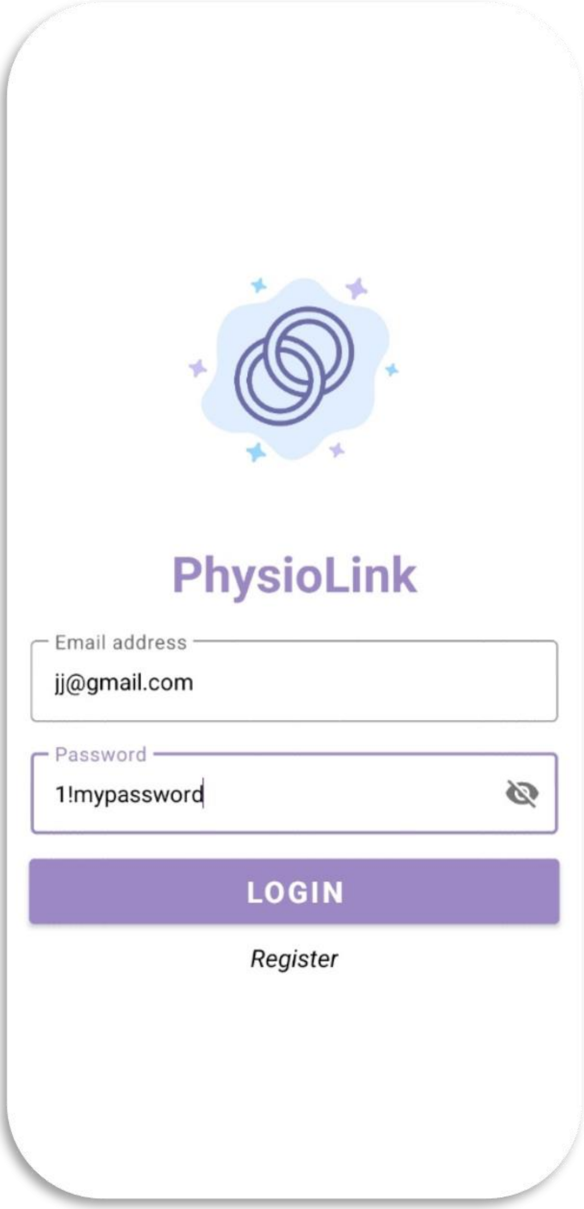


Password should contain a digit

With valid password:
The invitation code is deleted from the database upon successfully added the patient to the database, so it cannot be used by additional users.

Patient login flow:

Upon successful registration, the user will be returned to the Login page. Login system uses email and password login with Firebase Authentication.



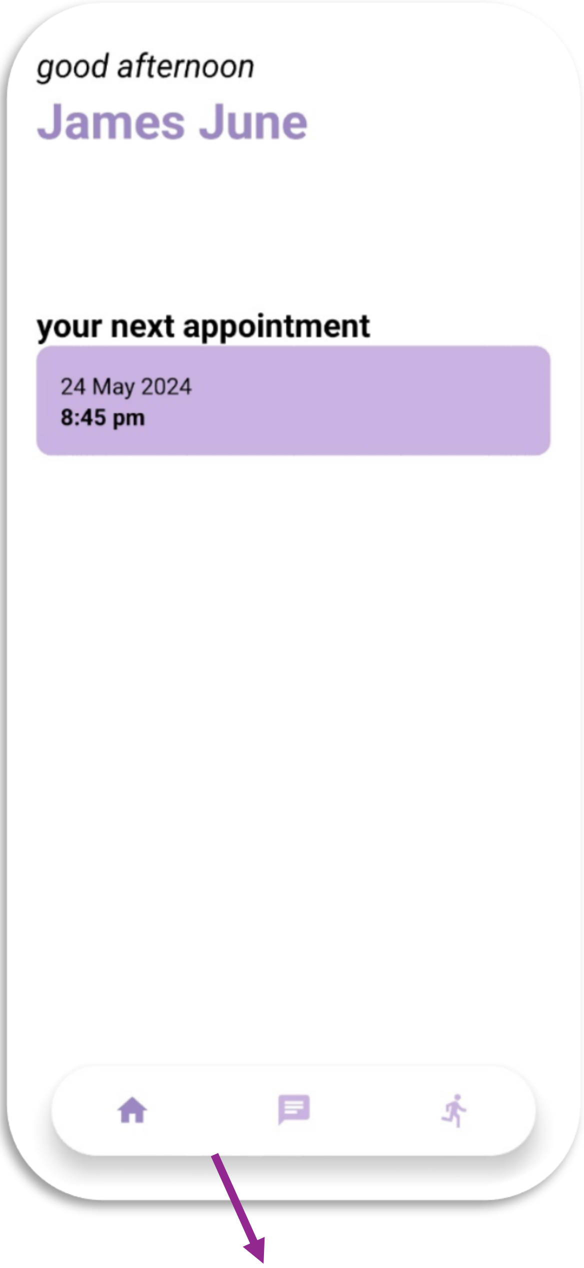
Email address

jj@gmail.com

Password

1!mypassword

Dashboard


good afternoon

James June

your next appointment

24 May 2024
8:45 pm

Upon successful login, the patient's data is retrieved from the database – including their ID, their PT's ID, and their personal information.

A time-sensitive greeting is displayed with the patient's name.

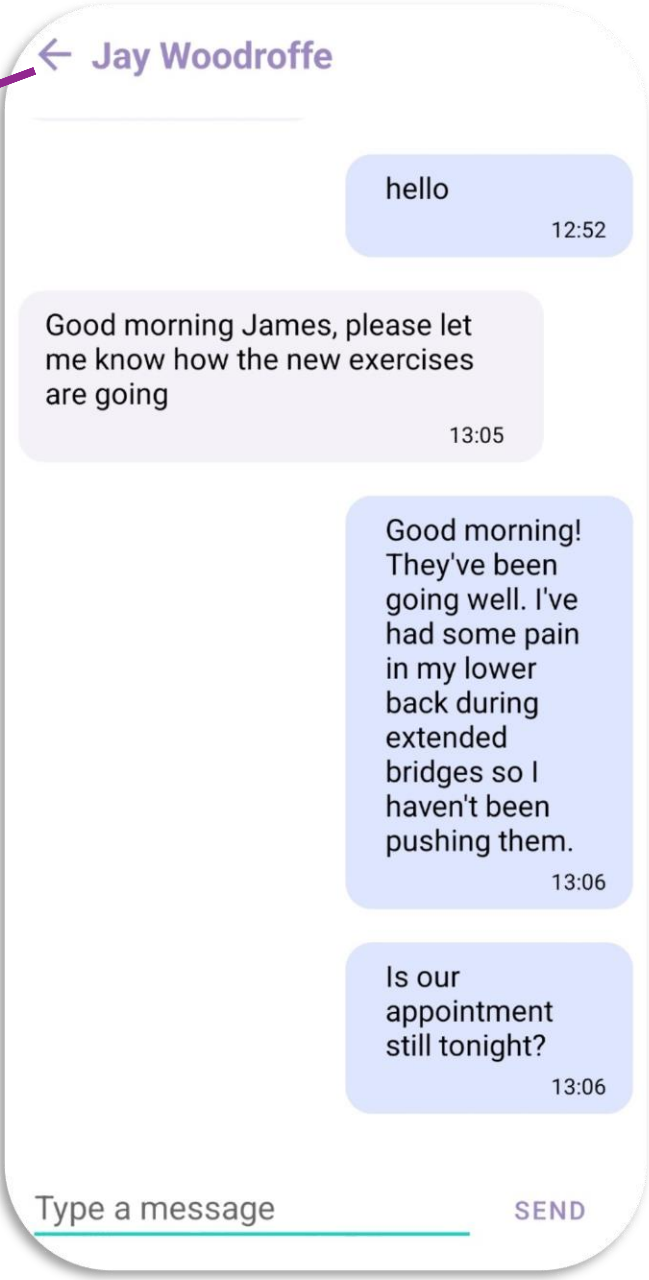
The database is queried to see if the patient has any future appointments, and if they do, it displays the upcoming one on the dashboard.

Custom Navigation Bar: Rounded bottom navigation bar allows the patient to easily change between the dashboard, the chat and their exercises.

Chat Page:

The patient's chat with their physiotherapist is loaded from Firebase and displayed in a Recycler View in MessageCards. The senderId is checked to decide whether to display the message as an incoming or outgoing message.

Chat



Jay Woodroffe

hello
12:52

Good morning James, please let me know how the new exercises are going
13:05

Good morning! They've been going well. I've had some pain in my lower back during extended bridges so I haven't been pushing them.
13:06

Is our appointment still tonight?
13:06

Back button returns the user to the Dashboard

The PT's name is displayed at the top of the page.

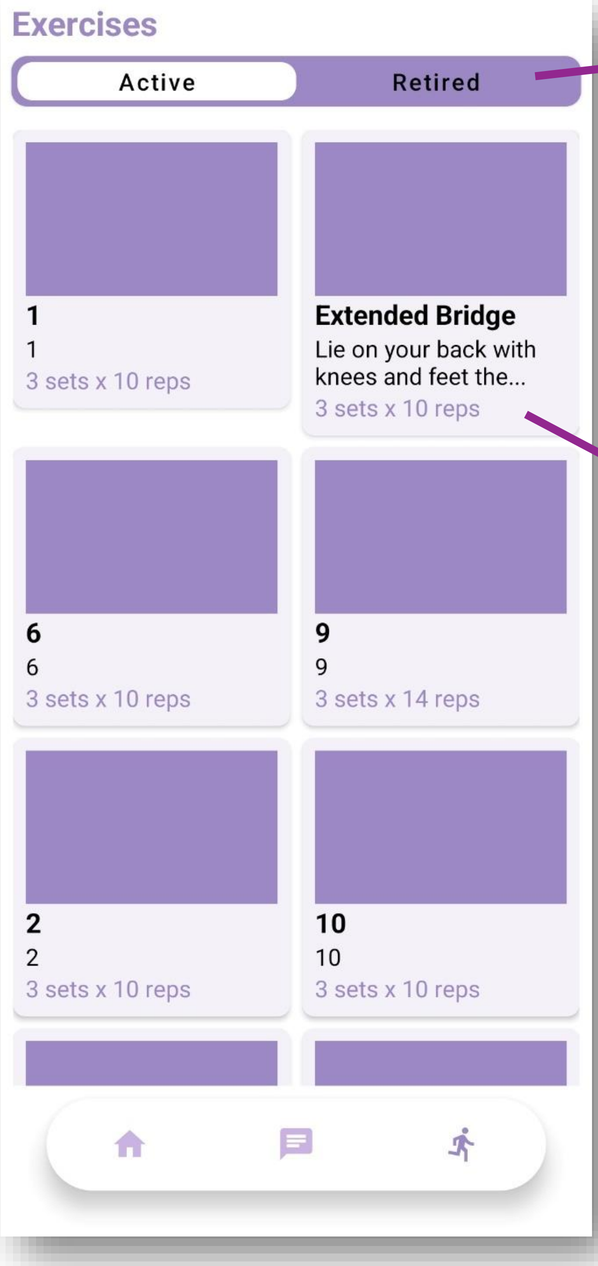
The messages are displayed chronologically and displayed with their timestamp.

A messageListener checks regularly for new messages and updates the page with the new messages.

Exercises Page:

The patient is able to view their active and retired (ie non-active) exercises. These are displayed in a grid view, with each individual exercise shown inside an ExerciseCard.

Exercises



Exercises

Active | Retired

1
1
3 sets x 10 reps

Extended Bridge
Lie on your back with knees and feet the...
3 sets x 10 reps

6
6
3 sets x 10 reps

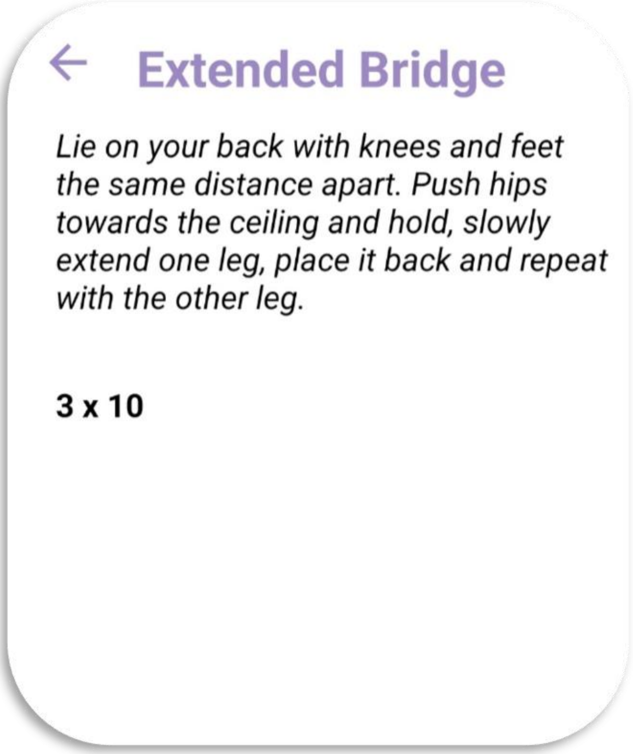
9
9
3 sets x 14 reps

2
2
3 sets x 10 reps

10
10
3 sets x 10 reps

Custom Toggle Bar:
Allows the patient to quickly switch between the exercise types. Asynchronicity is heavily taken into consideration and progress bars are displayed in case of slow database response. In case of new exercises being added, they will be displayed upon the tab being reloaded.

Exercise Detials



← Extended Bridge

Lie on your back with knees and feet the same distance apart. Push hips towards the ceiling and hold, slowly extend one leg, place it back and repeat with the other leg.

3 x 10

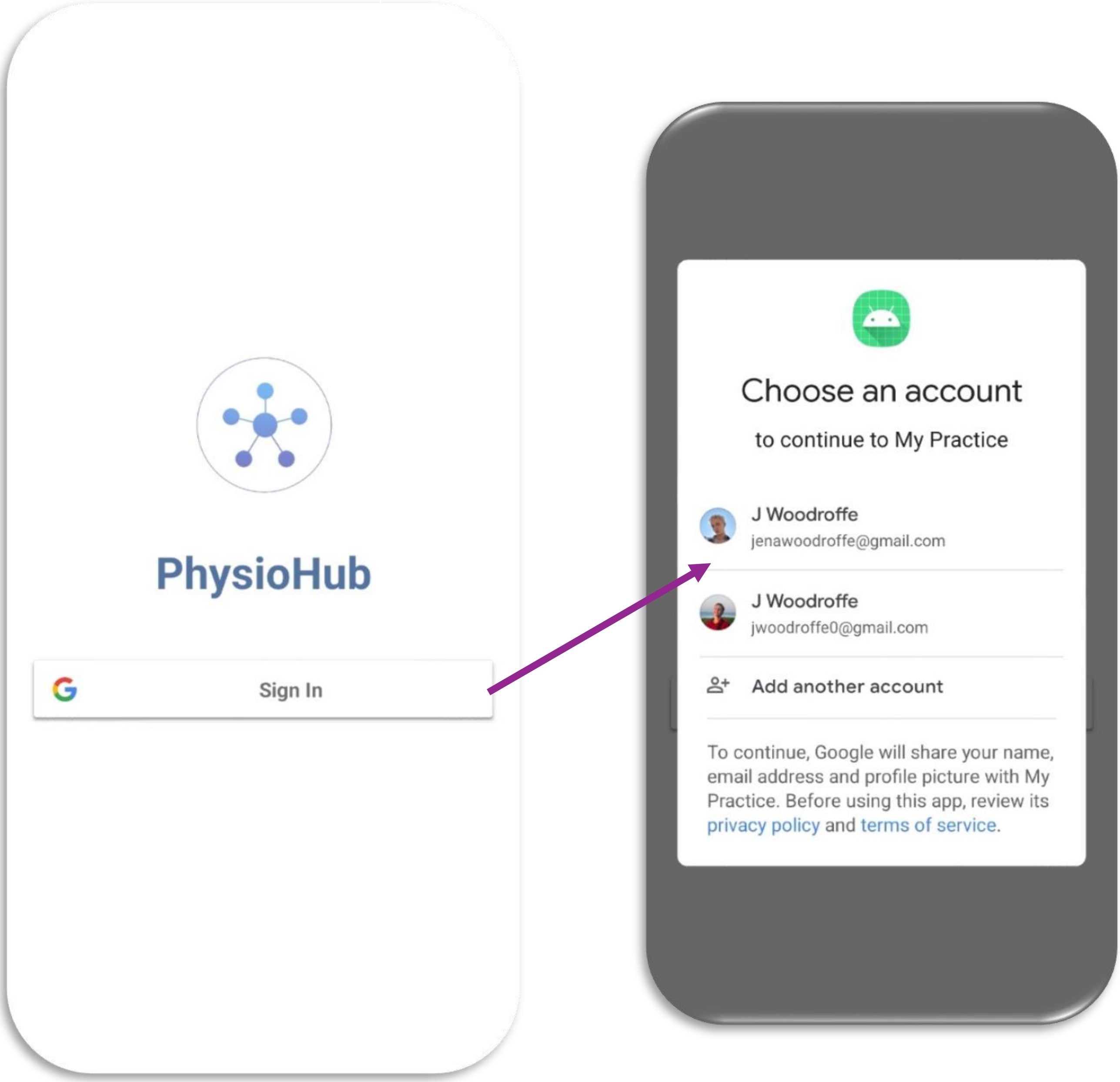
ItemClickListener:
Clicking on an exercise will open the exercise with all its details. The back button on this page returns the patient back to the Active Exercises tab.

Results – PhysioHub (Physiotherapists' app)

Physiotherapist registration flow:

Signing in: *is handled by Firebase Authentication with Google Sign in. If the user clicks Sign in, and they haven't previously logged in before, they will be prompted to register with all their necessary data.* ***Navigation*** *between registration screens is seamless using the back buttons.*

Login



Choose an account

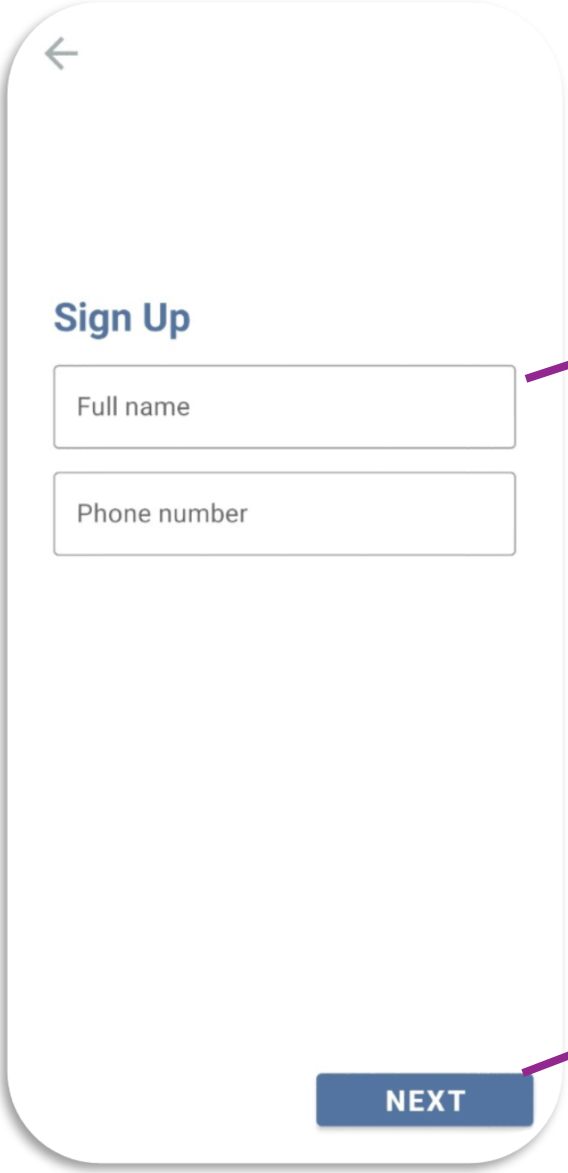
to continue to My Practice

J Woodroffe
jenawoodroffe@gmail.com

J Woodroffe
jwoodroffe0@gmail.com

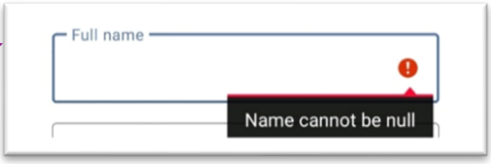
To continue, Google will share your name, email address and profile picture with My Practice. Before using this app, review its privacy policy and terms of service.

Contact information

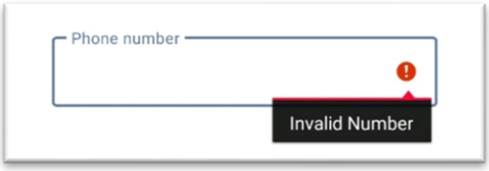


Data validation rules:

1. For name: not null, only letters
2. For cellphone number: entered data comprises of only digits, and all valid characters (digits and not the spaces between them) add up to a length of 10 – ie the length of a valid phone number



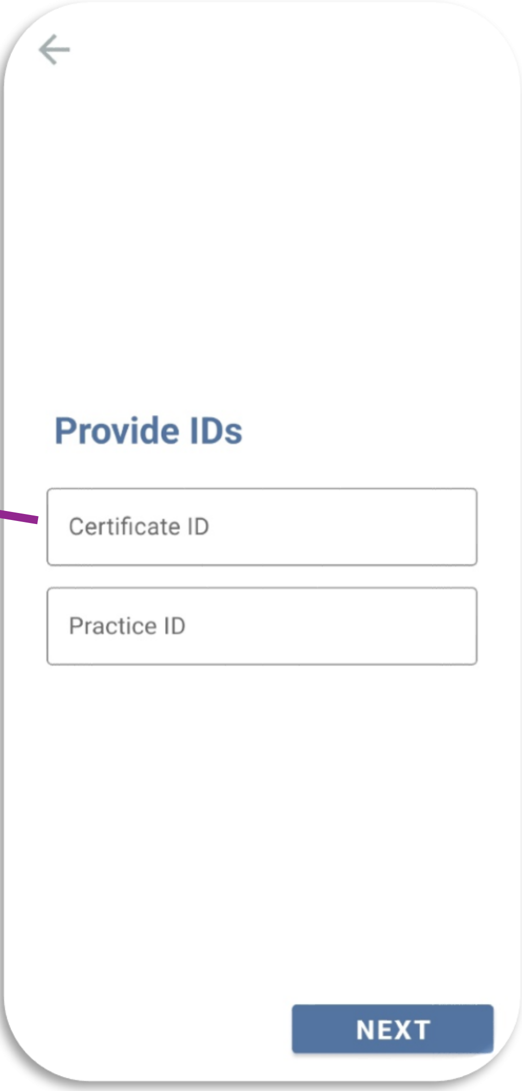
Name cannot be null



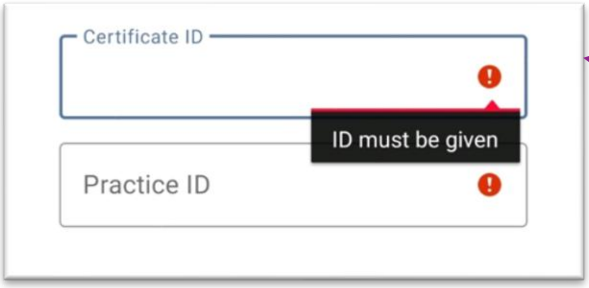
Invalid Number

Upon entry of valid data, the user progresses to the next registration page.

IDs



Certificate IDs need to be unique and are checked during this process as they will be used to uniquely identify PTs



ID must be given

Once a valid set of data is given (as shown below) and the ***NEXT*** button is pressed, the doctor will be allowed to progress to the next and final password registration screen as shown on the next page

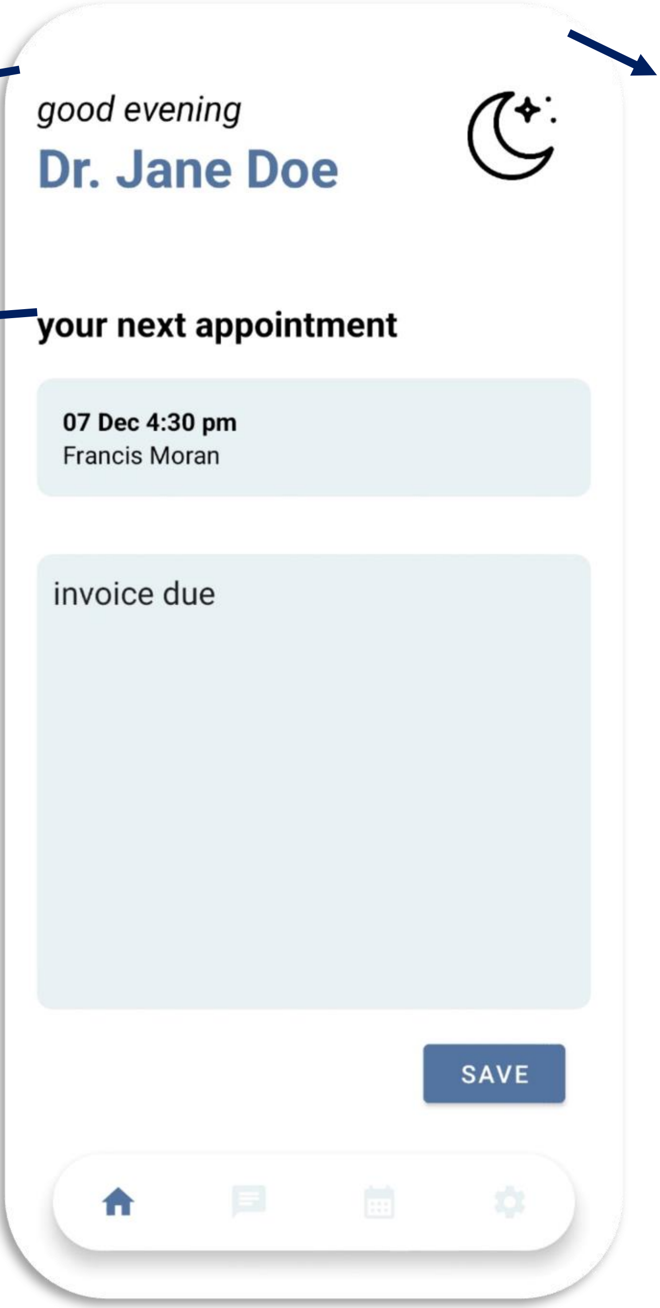
Dashboard - Physiotherapists

Greeting by name

After receiving the PT's authentication details, I queried the rest of their details from the database to greet them by name

Displaying their next appointment

I also query the appointments that are registered to the current PT and find the next appointment occurring after the current time. I show the date, time and patient name of this appointment.



good evening

Dr. Jane Doe

your next appointment

07 Dec 4:30 pm
Francis Moran

invoice due

Time-sensitive greeting and icon

Depending on the time of that, the greeting will be displayed as 'good morning', 'good afternoon' or 'good evening' with the respective icon

Notepad

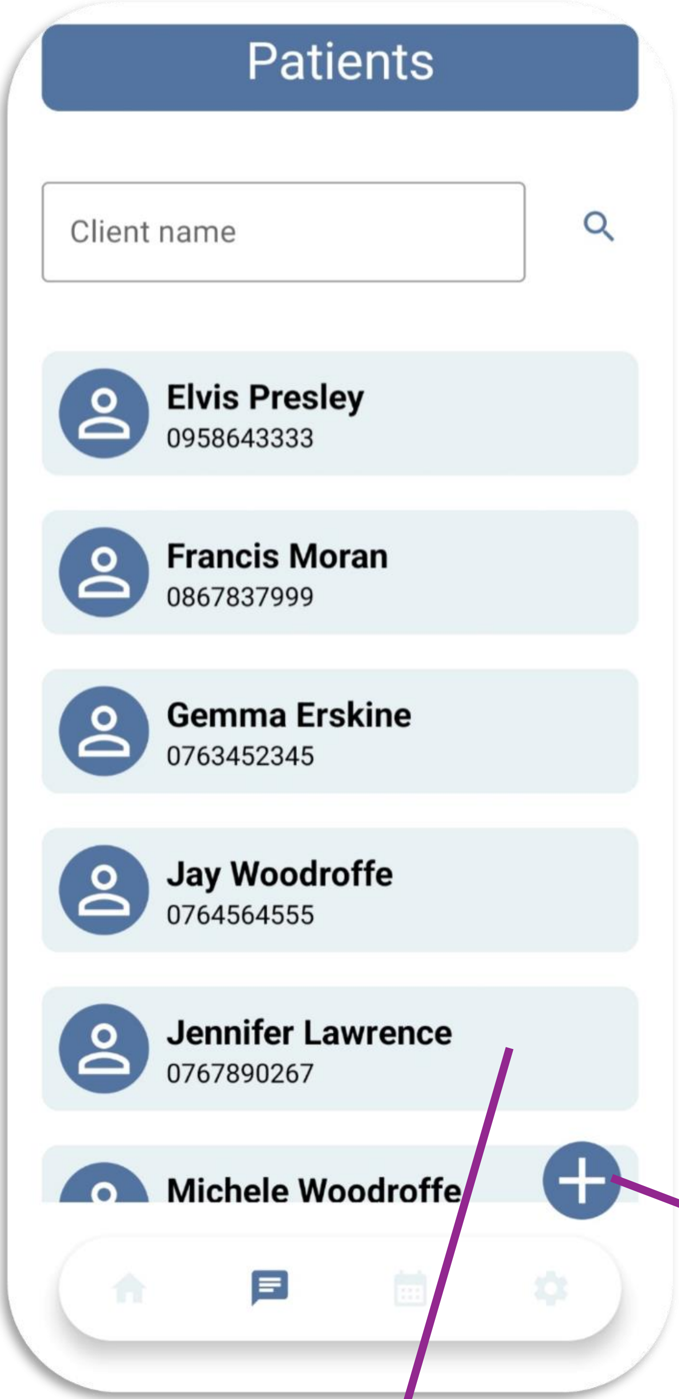
I created a simple notepad using a multiline edit text and stored the notes using SharedPreferences. If the doctor wishes to remind themselves of anything, they can add the note here and click save to save it to memory.

Custom navigation bar:

Allows the users to quickly switch between the dashboard, their patients, their calendar and settings

Patient flow - Physiotherapists

Patients recyclerview



Patients

Client name

Elvis Presley
0958643333

Francis Moran
0867837999

Gemma Erskine
0763452345

Jay Woodroffe
0764564555

Jennifer Lawrence
0767890267

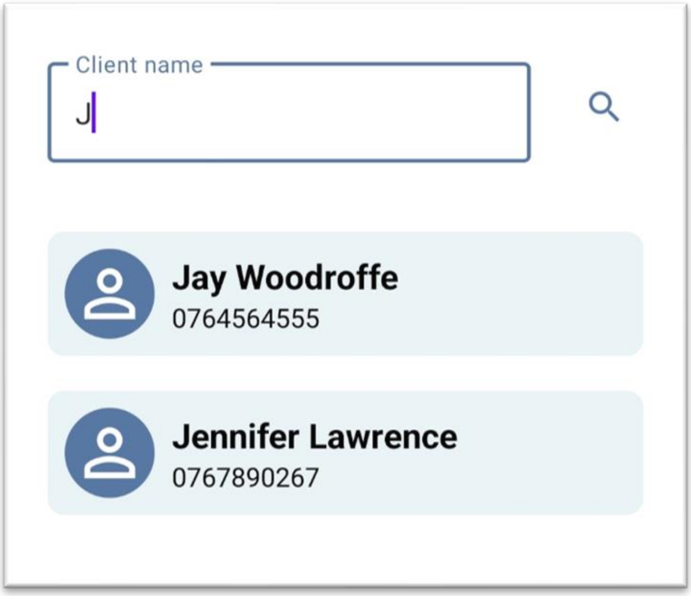
Michele Woodroffe

On creation

When this screen is loaded in, I query the patients' database using the current physiotherapist's ID and I order the clients alphabetically.

Search function:

The edit text with the hint "Client name" allows the user to complete a case-insensitive search/filtering of the patients/clients registered to this PT. These filtered patients will be displayed after the search icon is pressed.



Client name

J

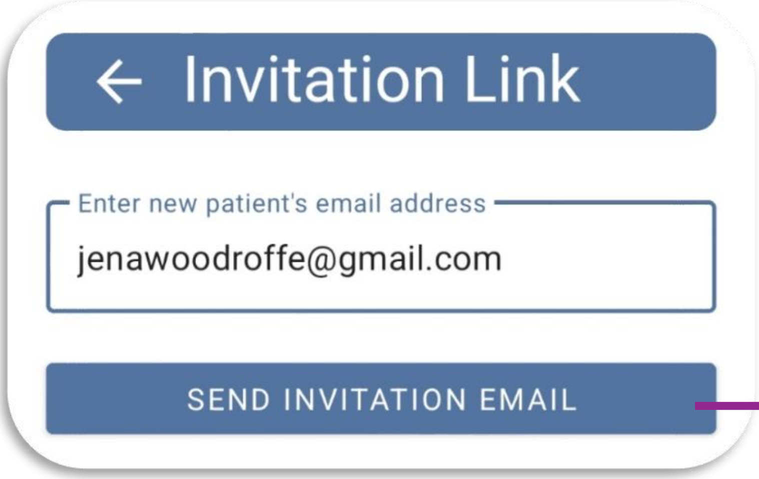
Jay Woodroffe
0764564555

Jennifer Lawrence
0767890267

Opens the invitation activity shown in the next page.

Clicking a patient from the list opens the information page for this specific user.

Invitation page

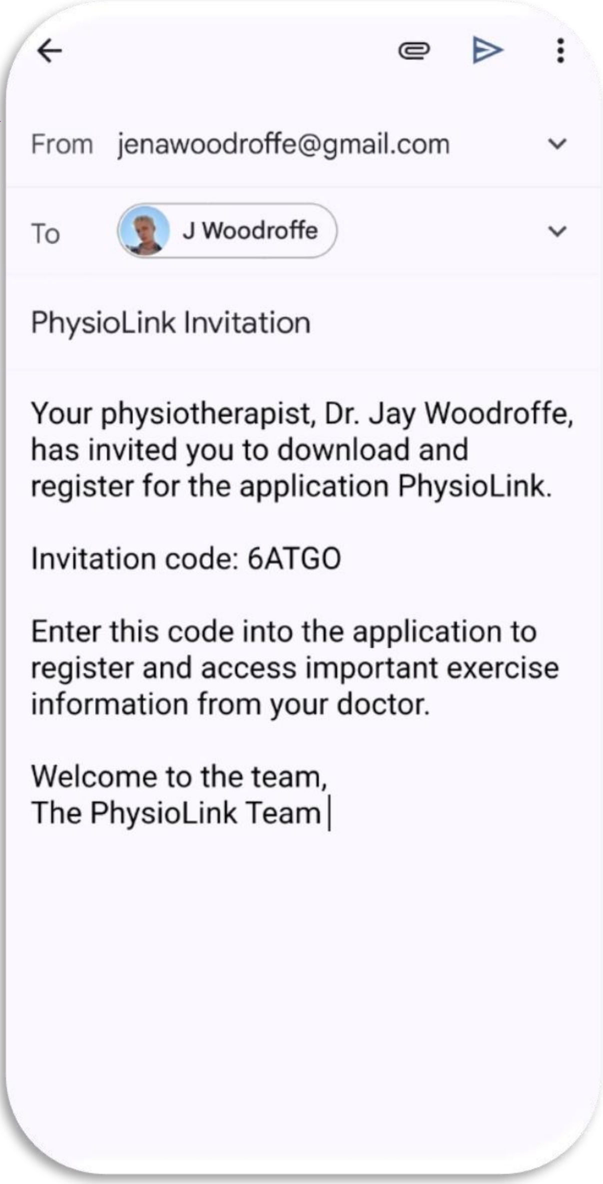

← Invitation Link

Enter new patient's email address

jenawoodroffe@gmail.com

SEND INVITATION EMAIL

The PT is able to enter their new patient's email address into this page. When they click the button, a unique 5-character invitation code is generated and an Gmail intent is sent to the Gmail app.


From jenawoodroffe@gmail.com

To J Woodroffe

PhysioLink Invitation

Your physiotherapist, Dr. Jay Woodroffe, has invited you to download and register for the application PhysioLink.

Invitation code: 6ATGO

Enter this code into the application to register and access important exercise information from your doctor.

Welcome to the team,
The PhysioLink Team

Once the email has been sent successfully, this invitation code, along with the PT's certificateID and an expiration date is added to the invitations collection. By adding the certificate ID, we can bind the new patients with the PT that invited them.

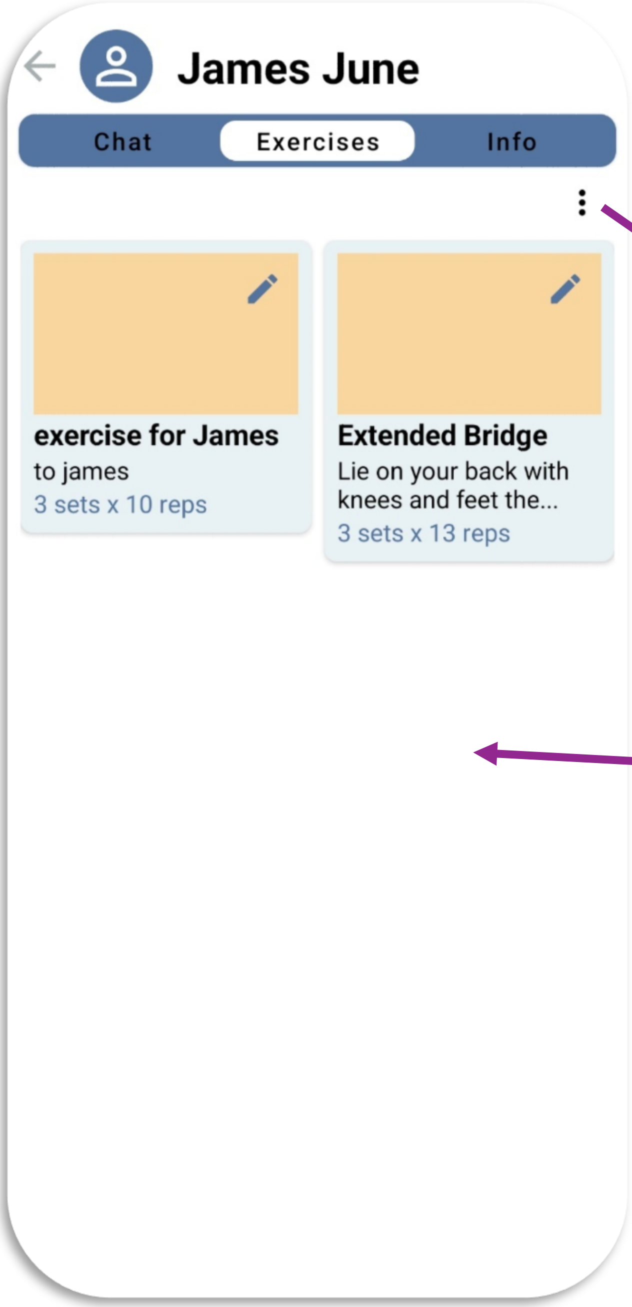
This allows the PT's to not have to manually register each of their patients and their relevant data. Instead, by sending the code and allowing patients to register, they can supply their own information then.

Patient information - exercises

When a PT clicks on a patient, that patients page will open. This gives the PT access to the patient's information, exercises and chat.

The exercises tab has a variety of functionalities. I will break them down into Viewing, Managing, Creating and Editing.

Patient Exercise Tab

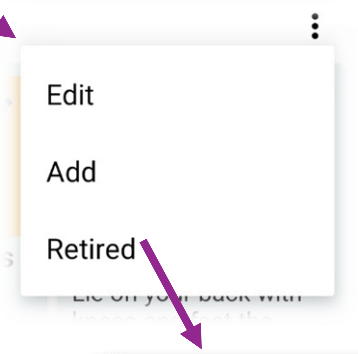


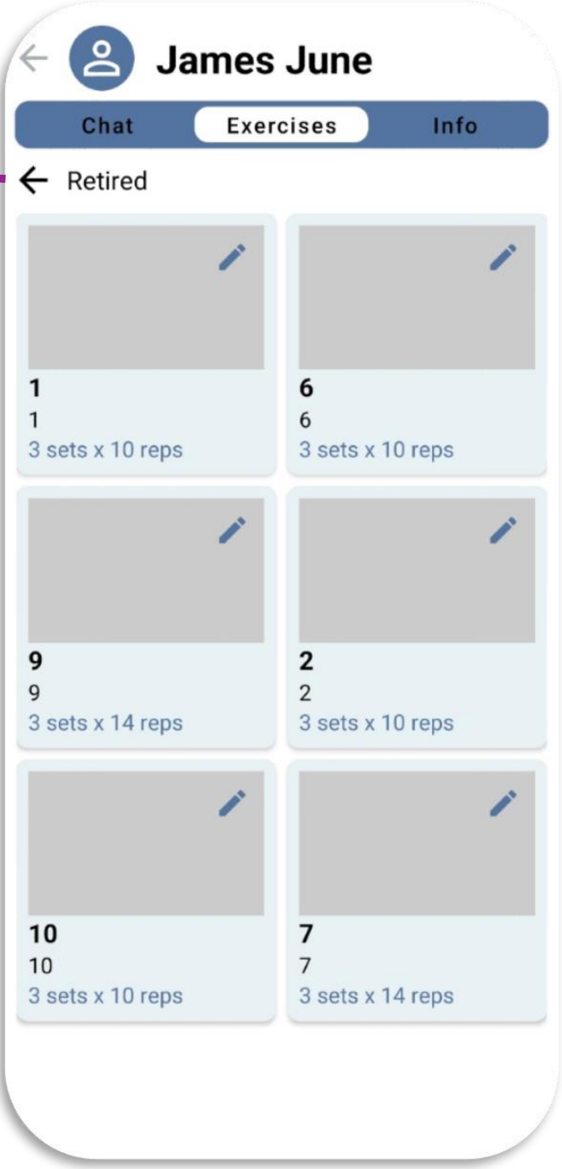
exercise for James
to james
3 sets x 10 reps

Extended Bridge
Lie on your back with knees and feet the...
3 sets x 13 reps

Exercise Functionalities:

1. ***Viewing active and retired*** *(non-active) exercises – Active exercises are displayed in orange and the retired ones in grey*





1
1
3 sets x 10 reps

6
6
3 sets x 10 reps

9
9
3 sets x 14 reps

2
2
3 sets x 10 reps

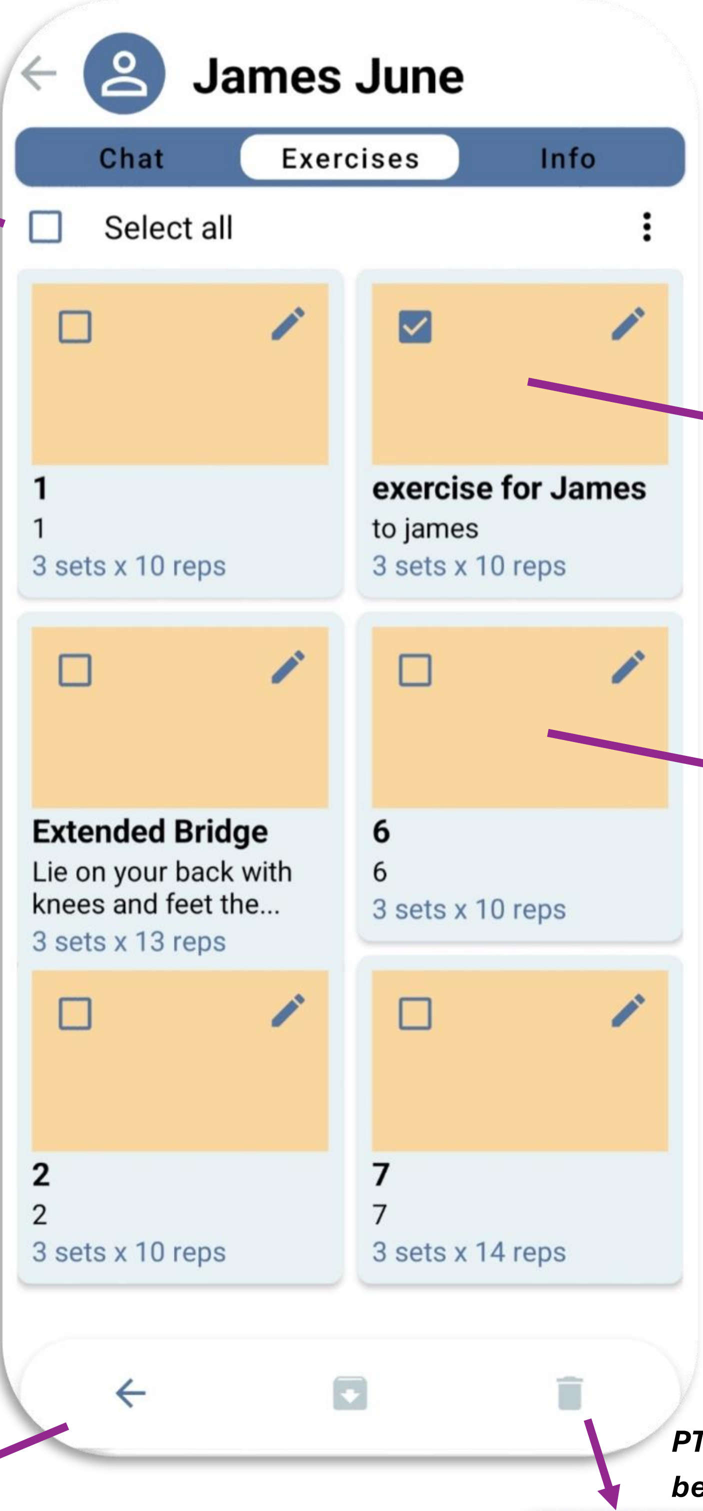
10
10
3 sets x 10 reps

7
7
3 sets x 14 reps

Exercise Functionalities:

2. ***Managing exercises –*** *quick selection option and the ability to retire/unretire or delete exercise seamlessly.*

Select All checkbox – *appears when selection mode is on, allows the user to quickly select or deselect all the active exercises*



James June

Chat Exercises Info

□ Select all

□ **1**
1
3 sets x 10 reps

☑ **exercise for James**
to james
3 sets x 10 reps

□ **Extended Bridge**
Lie on your back with knees and feet the...
3 sets x 13 reps

□ **6**
6
3 sets x 10 reps

□ **2**
2
3 sets x 10 reps

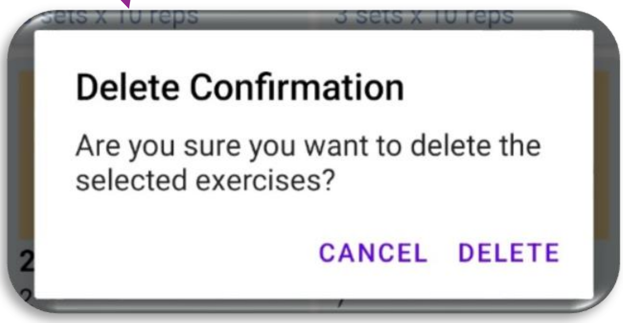
□ **7**
7
3 sets x 14 reps

OnLongClickListener – *listener added to each item in the gird view. If it is triggered, it will turn on selection mode (all the checkboxes will appear), and the item it was trigger on will be seleced*

OnItemClickListener – *once selection mode is on, simply clicking anywhere in the exercise will select it (checkbox will be ticked)*

Bottom navigation bar – *appears once selection mode is on. Allows the PT to exit selection mode, archive/retire the selected exercises or to delete them.*

PT is asked for confirmation before delete is carried out



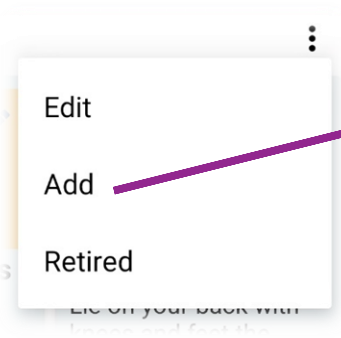
Delete Confirmation

Are you sure you want to delete the selected exercises?

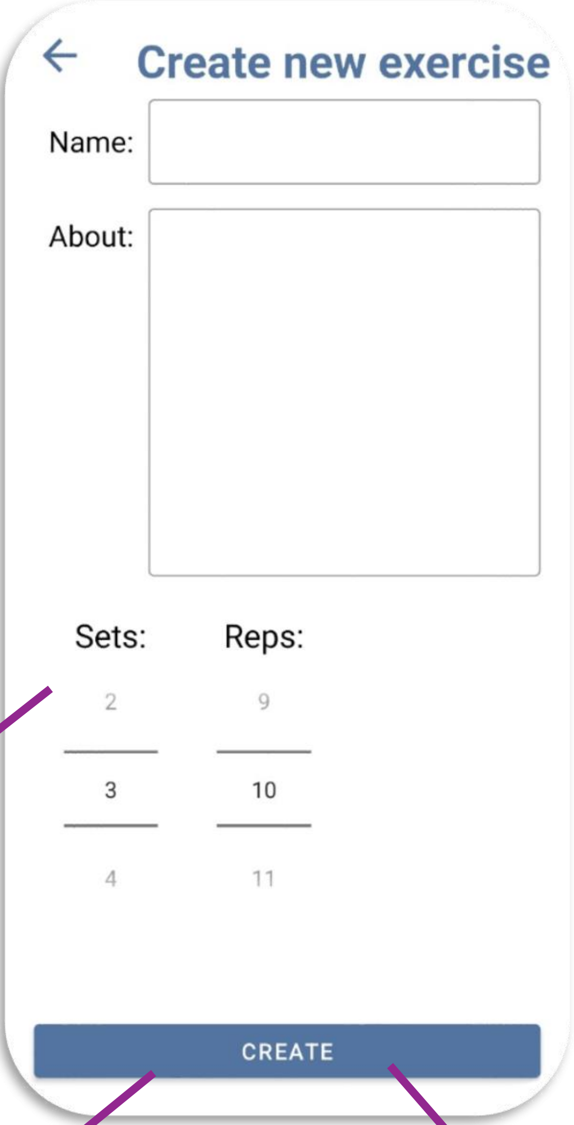
CANCEL DELETE

Exercise Functionalities:

3. ***Creating exercises –*** *allows the PT to create an exercise for the selected patient and it will be displayed immediately after*



NewExercise



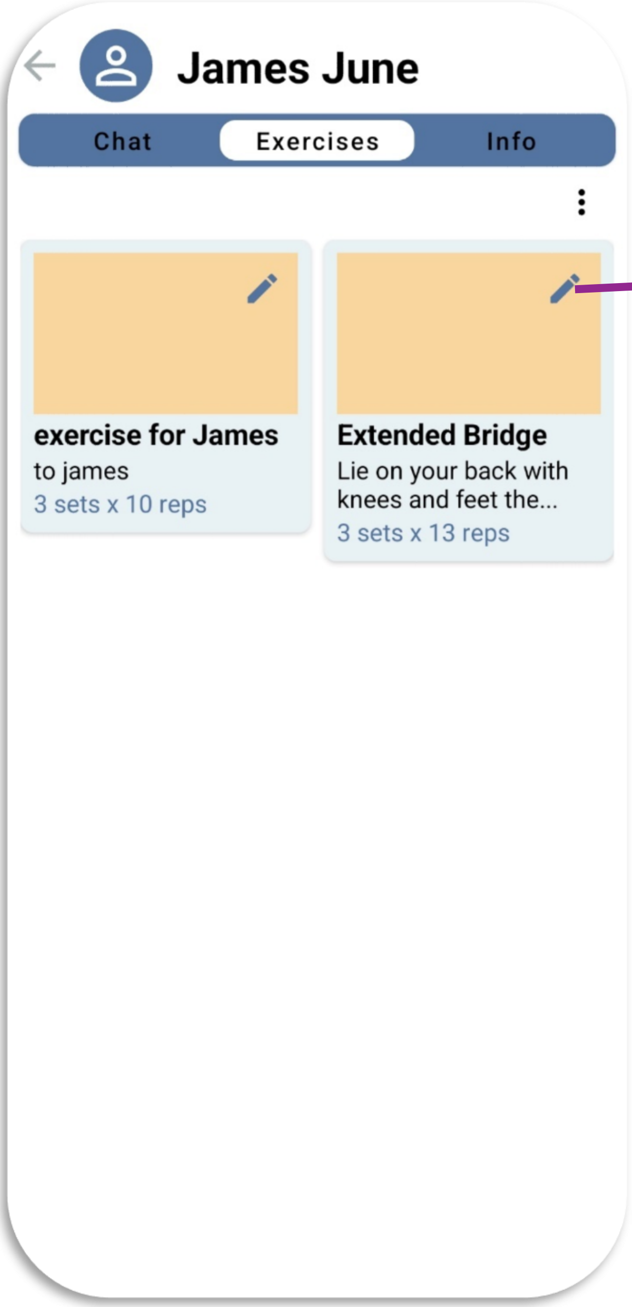
NumberPickers *are used to for the PT to easily set the number of sets and reps*

Once the ExerciseModel is complete, it will be sent to ExerciseDataAccess to add it to the Firestore. The PT will then be returned to the Active Exercises of the Patient and the new exercise will be displayed.

Checks the largest exercise ID currently existing in the database (since Firestore IDs are always strings, I needed to add a manual unique ID in order to display these exercises in a GridView and be able to get their numerical IDs easily

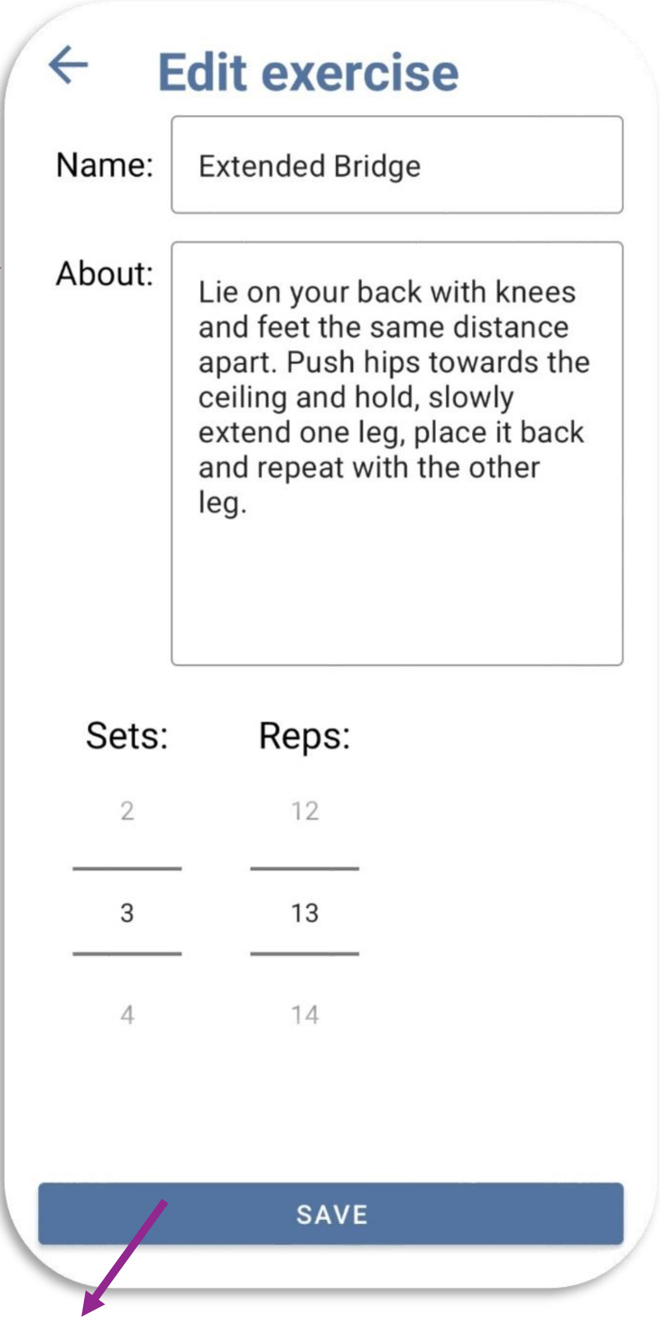
Exercise Functionalities:

4. ***Editing exercises –*** *allows the PTs to quickly alter any of the information for a given exercise.*



exercise for James
to james
3 sets x 10 reps

Extended Bridge
Lie on your back with knees and feet the...
3 sets x 13 reps



Name: Extended Bridge

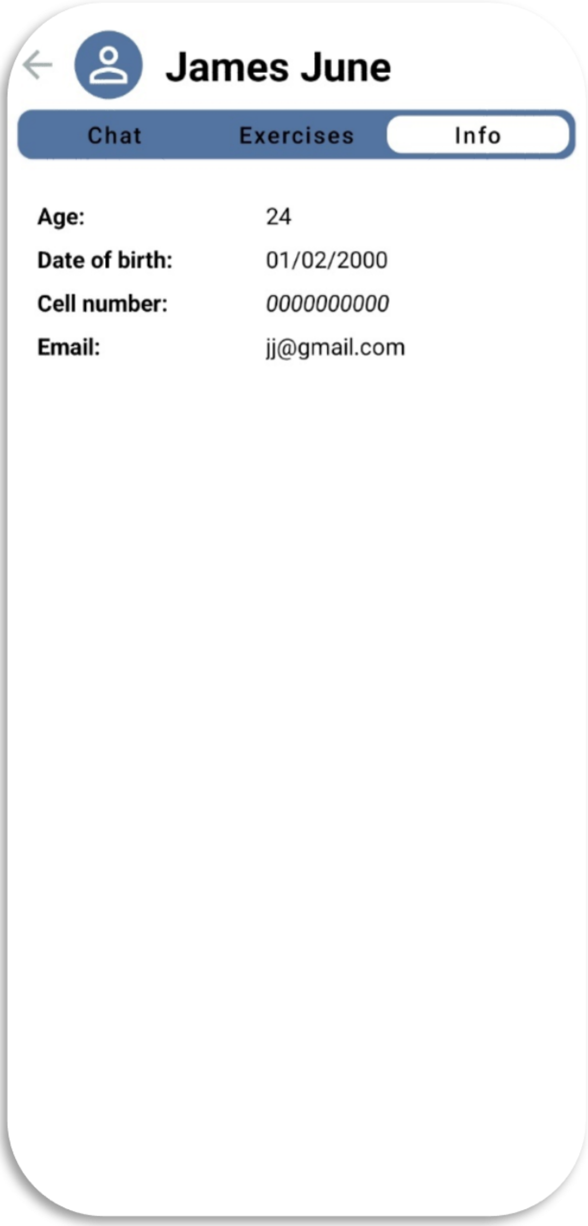
About: Lie on your back with knees and feet the same distance apart. Push hips towards the ceiling and hold, slowly extend one leg, place it back and repeat with the other leg.

Sets: 2 3 4

Reps: 12 13 14

By clicking on the edit button in the top right hand corner of any of the exercises will open it with its details loaded in the same activity that was used to create new activities but with its

Save button clicked: The exercise model with the updated information will be sent to ExerciseDataAccess and the relevant exercise will be modified. Upon returning back to the exercises tab, the updated exercise will be displayed.



James June

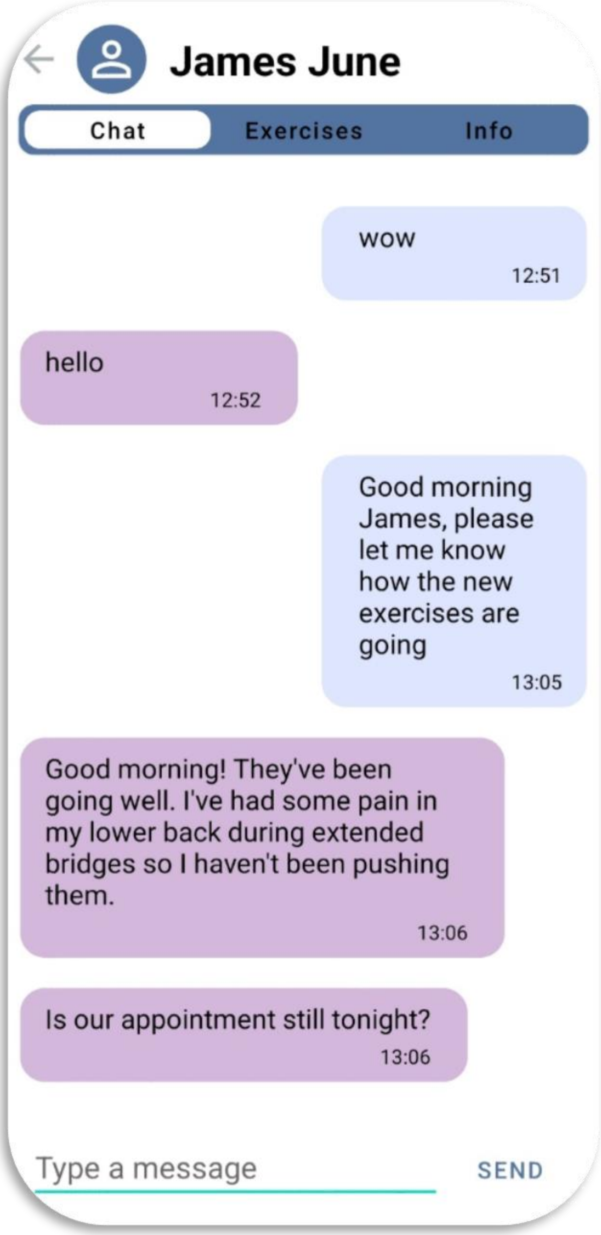
Age:	24
Date of birth:	01/02/2000
Cell number:	0000000000
Email:	jj@gmail.com

Patient information – info

When the PT clicks the "info" toggle on the custom toggle bar, it will open a fragment with the relevant patient's information. This information is derived from the information each patient is required to give upon registration.

Patient information – chat

The Chat toggle allows the PTs to text directly with their patients. Each message is added to a subcollection of this specific chat with its senderId and timestamp. The timestamp is used to display the time the message is sent and to order it chronologically. The senderId is used to determine how to display the message, either as an incoming or outgoing message.



James June

wow
12:51

hello
12:52

Good morning James, please let me know how the new exercises are going
13:05

Good morning! They've been going well. I've had some pain in my lower back during extended bridges so I haven't been pushing them.
13:06

Is our appointment still tonight?
13:06

Type a message

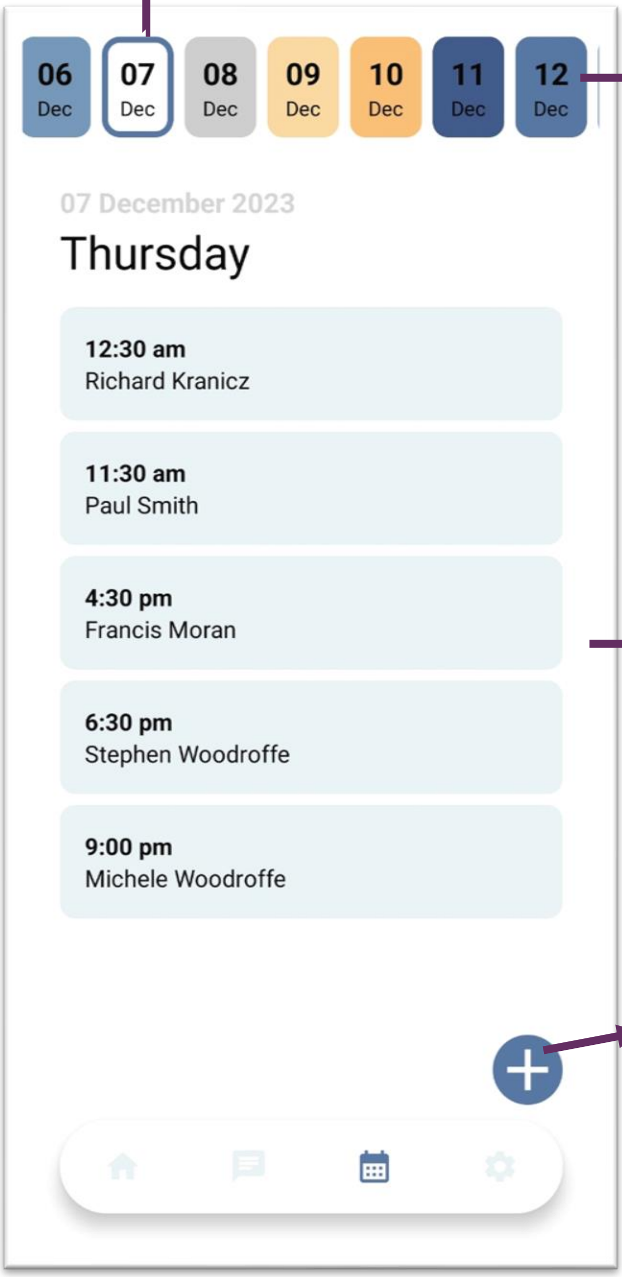
Message listeners are used to check if there are any new messages and then Chat fragment is updates as necessary to allow for punctual and smooth communication.

Calendar and appointments

Most of the code created related to the appointments, how their displayed and the data access they require was created last semester. But to ensure that the entire project is represented and explained here, I have included the results and explanations.

Selected day: the currently selected day is shown in white with a blue boarder and the date is displayed in the label below

Appointments



07 December 2023

Thursday

12:30 am
Richard Kranicz

11:30 am
Paul Smith

4:30 pm
Francis Moran

6:30 pm
Stephen Woodroffe

9:00 pm
Michele Woodroffe

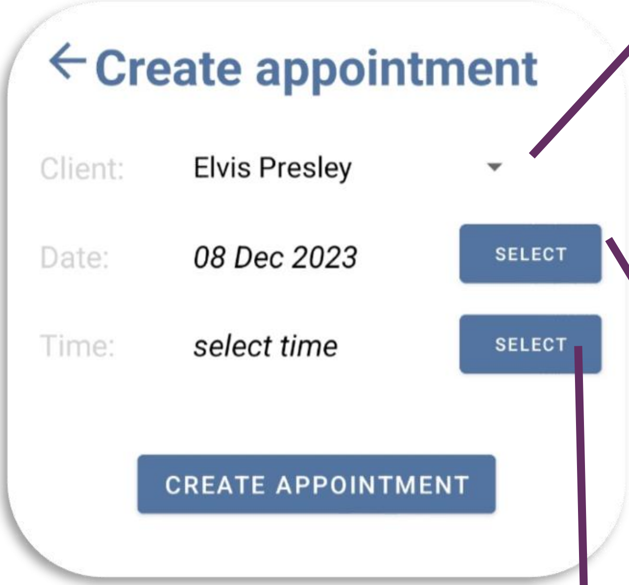
Calendar scroll view:
The top of the screen includes a custom made horizontal scroll view that displays the dates. It starts with the current day and displays the subsequent 50 days, allowing the doctor to schedule and create upcoming appointments. The days are color coded: with Saturday and Sunday being the two days shown in warm colours. This allows the user to quickly position which date corresponds to which day of the week.

Single day schedule:

- Whichever day is selected, a query will be run through the appointments database and the appointments that the PT has for that day will be displayed in chronological order – showing the time and name of the patient

Button press will:
Pressing this button will take the PT to the new appointment screen where they can add a new appointment to their schedule. This screen is shown on the next page. Important note: if the PT is currently on a certain day in the calendar view, this day will be passed to the new appointment activity. This is another feature I added to try make the app as intuitive as possible, as it made sense to me that if a PT is checking their schedule for the 20th of Jan, and went to make a new appointment, it is fairly likely they want that appointment to be on the 20th Jan. This date is of course editable if this is not the case.

NewAppointment



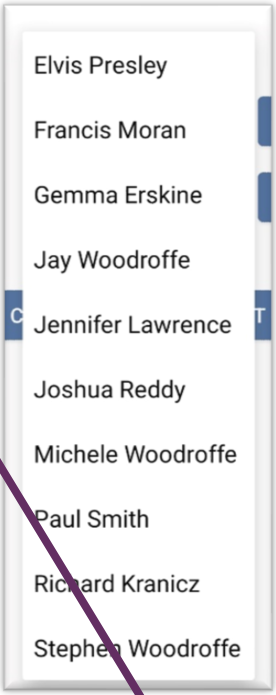
← Create appointment

Client: Elvis Presley

Date: 08 Dec 2023 SELECT

Time: select time SELECT

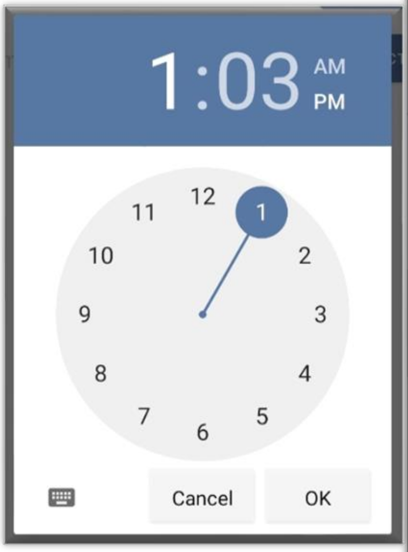
CREATE APPOINTMENT



- Elvis Presley
- Francis Moran
- Gemma Erskine
- Jay Woodroffe
- Jennifer Lawrence
- Joshua Reddy
- Michele Woodroffe
- Paul Smith
- Richard Kranicz
- Stephen Woodroffe

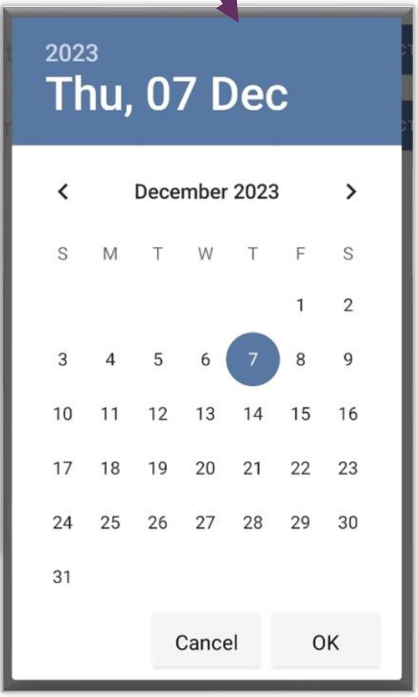
Selecting the patient:
To select the patient that the new appointment is for, the PT is given a drop down menu of all of the clients that are linked to them. They simply need to select one of their names and that name will be displayed as the Client.

Selecting the appointment time:
Pressing this select button will bring up another built in Android feature – the Time Picker – that I have also customised to fit the color and style of the rest of the app. Once the PT is satisfied with the time and selects OK, the time will be displayed next to Time: on the appointments screen.



1:03 AM PM

Cancel OK



2023
Thu, 07 Dec

‹ December 2023 ›

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

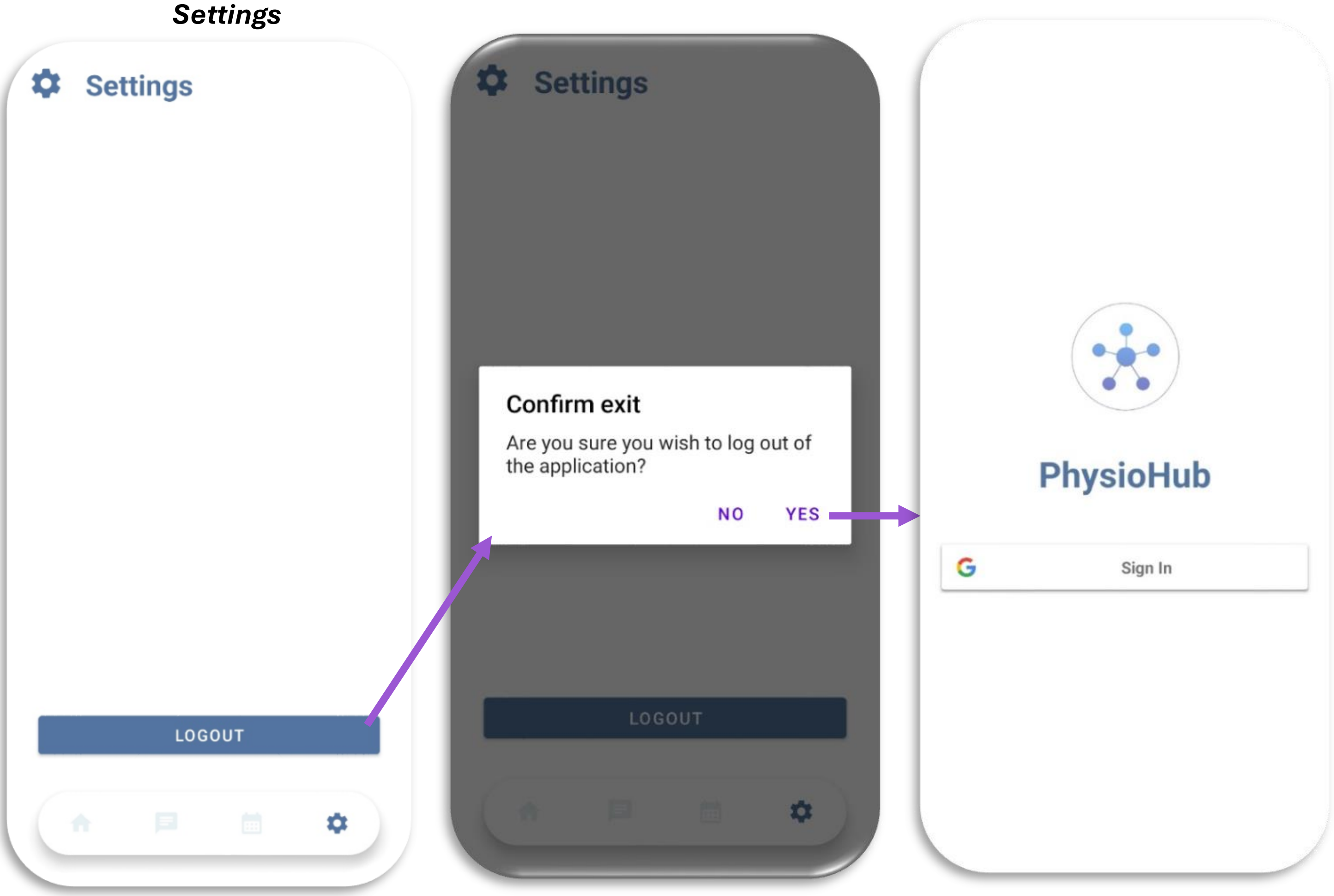
Cancel OK

Selecting the appointment date:
If the suggested date isn't actually when you would like the appointment to be, clicking on the select button will bring up the built in calendar where you can select a new date. Pressing ok will display the new date next to Date.

Settings and Loging Out

The settings tab allows the user to quickly log out of their account.

Settings



Confirm exit

Are you sure you wish to log out of the application?

Future work and expansion

There are many more features and improvements I hope to make on this application to make it more useful and effective.

1. **Improvement of the Appointments Functionality:**
   Using Firebase Cloud Messaging, I wish to send notifications to the devices of patients in the days leading up to their appointments, reminding them of the time. I want to add locations to appointments, potentially linking to Google Maps. I will also give patients the opportunity to cancel their appointments through the application as long as it is 24 hours prior to their appointment.
2. **Improvement of the Chat Functionality:**
   Tracking whether or not messages have been read, using Firebase Cloud Messaging to notify users of new messages and also displaying the number of new messages from a patient/doctor somewhere else in the application to draw attention to unread messages. Allowing images/videos to be sent
3. **Improvement of the Exercises Functionality:**
   Patients should be able to upload videos or images they have on their device to their exercises they have assigned to them. This would be linked to their local storage so as not to use too much Firestore storage.