



SAPIENZA
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MediTrex

Dependable Distributed Systems Report

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Repository link:

<https://github.com/samuelecervo/MediTrex>

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1 Introduction

MediTrex is a web app aimed to improve the management of medical treatments and personal health conditions. It allows patients to efficiently keep track of their medications, check-ups, symptoms and vitals. Moreover, it facilitates communication between patients and doctors and provides a complete overview of personal health. So, a patient can medically tracks their data, and that's the main reason for the name.

MediTrex will help a user to choose the most advisable doctor for each of their requests and allows them to be followed by a GP (General Practitioner). Moreover, a user can always change their own GP, in agreement with the new chosen doctor.

Unregistered users

When opening the app for the first time, a user is unregistered. Even so, there's a section of the app a new visitor could use without signing up. Indeed, the first feature available on the app is the Article page, a page where you can check out some news and daily papers about the medical field. There's a taste of it in the Homepage, where three articles are displayed. When signing up, a user can choose if registering as a patient or as a doctor. Depending on the choice, some specific fields could be required (e.g. the Medical Licence Id for a doctor).

Patients

The app tries to meet some requirements a user could need as a patient. Its main purpose is helping people to find the most suitable doctor for their needs and to keep track of their potential treatments. When a new patient enters the app, an empty medical record is created and the user will be able to fill it with all their medical data. This feature saves the patients the trouble of taking their medical history with them and the risk of losing it. Another feature for the patients is the appointment tracking. When a patient gets an appointment from a doctor, they can see them in their own dashboard, together with all their prescriptions and symptoms record.

Doctors

The app makes it easy for the doctors to communicate with their patients about their potential conditions or any kind of problem. They can accept a patient's request to follow them and they can always access to their medical record in order to learn everything about their anamnesis. Moreover, a doctor can give appointments to their patients and add, modify or delete any prescription they received earlier. In any moment, a doctor can choose to unfollow a patient or inform all their patients that they are on vacation.

2 Requirements

2.1 User Stories and Mockups

Hereafter, a list of all the user stories used to realise MediTrex and their corresponding mockups.

As an unregistered user I want to access the homepage so that I can read some main medical articles and news.

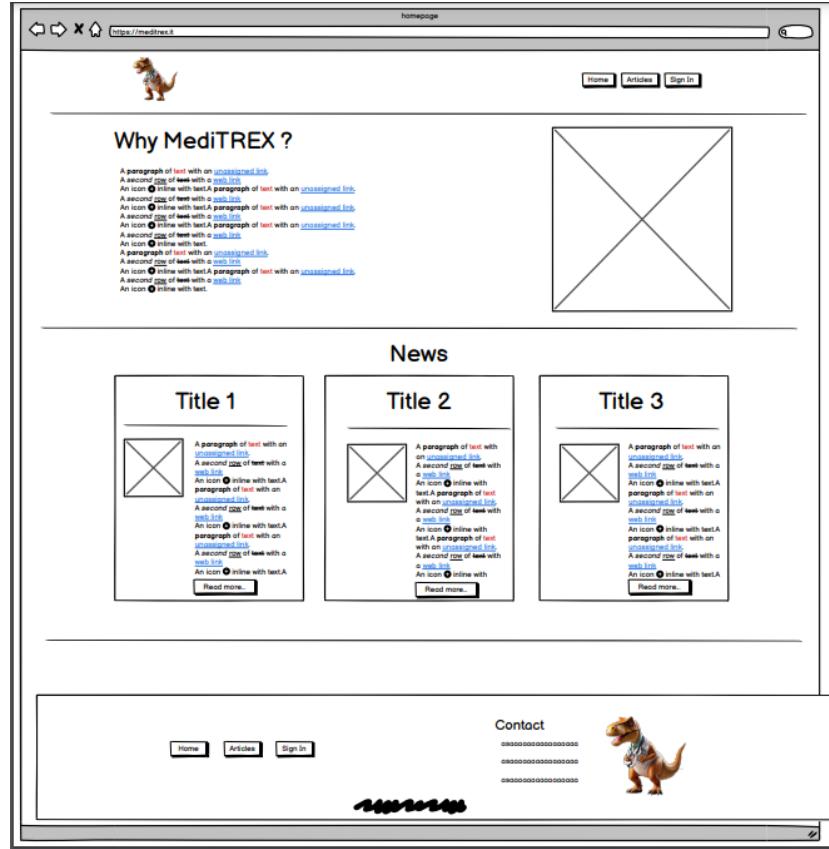


Figure 1: Homepage

As an unregistered user I want to access the Sign-Up page so that I can create an account as a patient.

As an unregistered user I want to access the Sign-Up page so that I can create an account as a doctor.

As a user I want to access the Sign-In page so that I can login with email and password.

As a user I want to logout so that I can end my session.

The screenshot shows a web browser window titled 'registration' with the URL 'https://meditrex.it/registration'. At the top left, there are tabs for 'Patient' and 'Doctor', with 'Patient' being the active tab. The main title 'MediTrex' is centered above the form fields. The form consists of several input fields: 'Name' (with placeholder 'Insert your name'), 'Surname' (with placeholder 'Insert your surname'), 'Date of birth' (with placeholder 'Insert your date of birth'), 'Gender' (with options 'Male', 'Female', and 'Other' each preceded by a checkbox), 'Tax ID code' (with placeholder 'Insert your Tax ID code'), 'Email' (with placeholder 'Insert your email'), 'Password' (with placeholder 'Create your password'), and 'Confirm password' (with placeholder 'confirm your password'). A 'Sign up' button is located at the bottom center of the form.

Figure 2: Registration as a Patient

The screenshot shows a web browser window titled "registration" at the URL <https://meditrex.it/registration>. At the top left, there are buttons for "Patient" and "Doctor", with "Doctor" being selected. The main title "MediTrex" is centered above a form. The form consists of several input fields and dropdown menus:

- Name:** Input field labeled "insert your name".
- Surname:** Input field labeled "insert your surname".
- Date of birth:** Input field with a date picker icon.
- Tax ID code:** Input field labeled "insert your Tax ID code".
- Gender:** Radio buttons for "Male" (checked), "Female", and "Other".
- Medical License ID:** Input field labeled "insert your medical license".
- Specialization:** Dropdown menu showing "areas".
- Email:** Input field labeled "insert your email".
- Password:** Input field labeled "create your password".
- Confirm password:** Input field labeled "confirm your password".

A "Sign up" button is located at the bottom center of the form.

Figure 3: Registration as a Doctor

The screenshot shows a web browser window titled "A Web Page" at the URL <https://meditrex.it/login>. The main title "MediTrex" is centered above a form. The form includes:

- E-mail:** Input field labeled "insert your e-mail".
- Password:** Input field labeled "insert your password".
- Remember me:** A checkbox labeled "Remember me".
- Sign in:** A "Sign in" button located below the password field.
- Sign up:** A "Sign up" button located below the "Sign in" button.

Figure 4: Login

As a user, I want to be able to edit my profile, so that I can customize information about me.

As a doctor (either specialized or GP) I want to update my biography within the app to provide information about my specialization and expertise to potential patients.

A Web Page

Hello, <username>

Profile

<username>

Date of birth

Tax ID code

Gender

Email

Password

Confirm password

Blocked field

Blocked field

Blocked field

Blocked field

Blocked field

Blocked field

Profile

Log out

Figure 5: Patient edit profile

A Web Page
https://

Hello, <username>

Profile

 <username>
Update image profile

Bio:
Add your bio here...

SAVE

Date of birth
 Blocked field

Tax ID code
Insert your Tax ID code
Blocked field

Gender
 Male Female Other
Blocked field

Medical License ID
Insert your medical license
Blocked field

Specialization
areas Blocked field

Email
Insert your email
Blocked field

Password
create your password

Confirm password
confirm your password
Update password

Profile

Log out

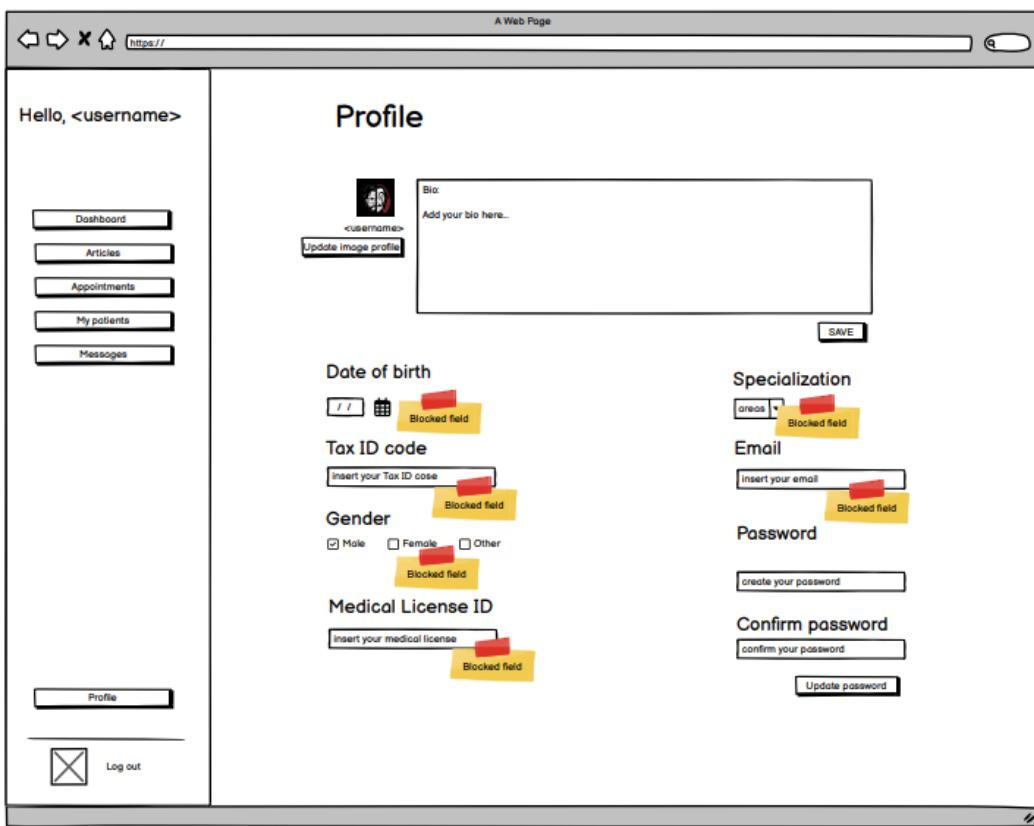


Figure 6: Doctor edit profile

As an unregistered user I want to click on a main article so that I can read it all.

As an unregistered user I want to access article page so that I can visualize all medical articles and news.

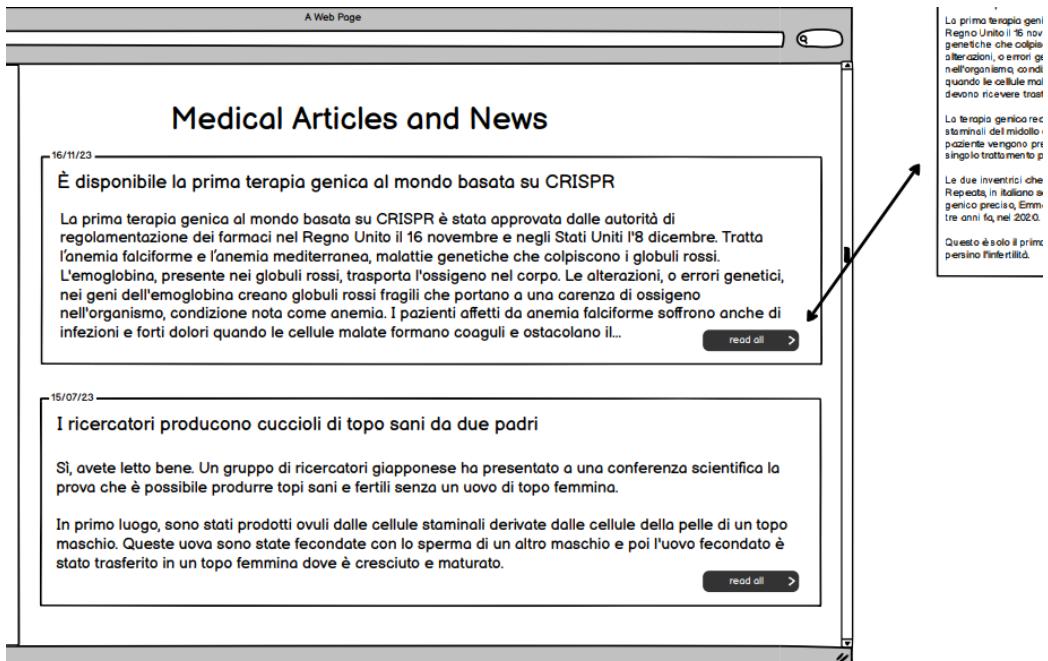


Figure 7: Article page

2.1.1 Patient section

As a Patient I want to access my Dashboard so that I can view my prescriptions and appointments.

As a Patient I want to have access to my Dashboard to keep track of my symptoms.

As a Patient I want to access my calendar so that I can view my upcoming appointments with my GP and any specialist.

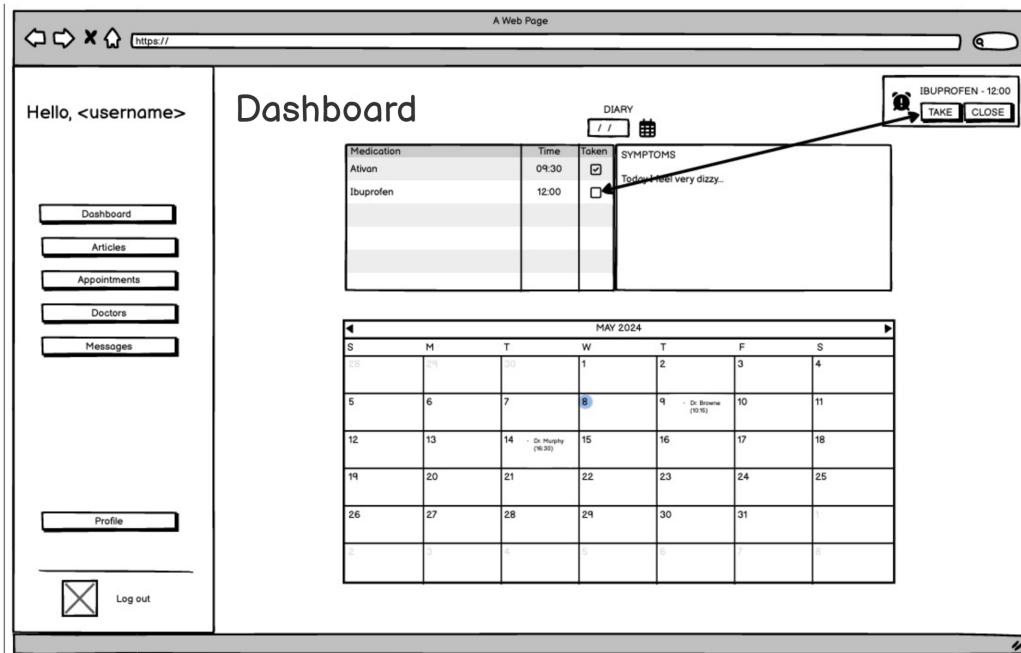


Figure 8: Client Dashboard

As a Patient I want to visualize a list of all the doctors so that I can add my GP and choose the best specialists for me.

As a Patient I want to send a request to a doctor so that I add them to my doctors.

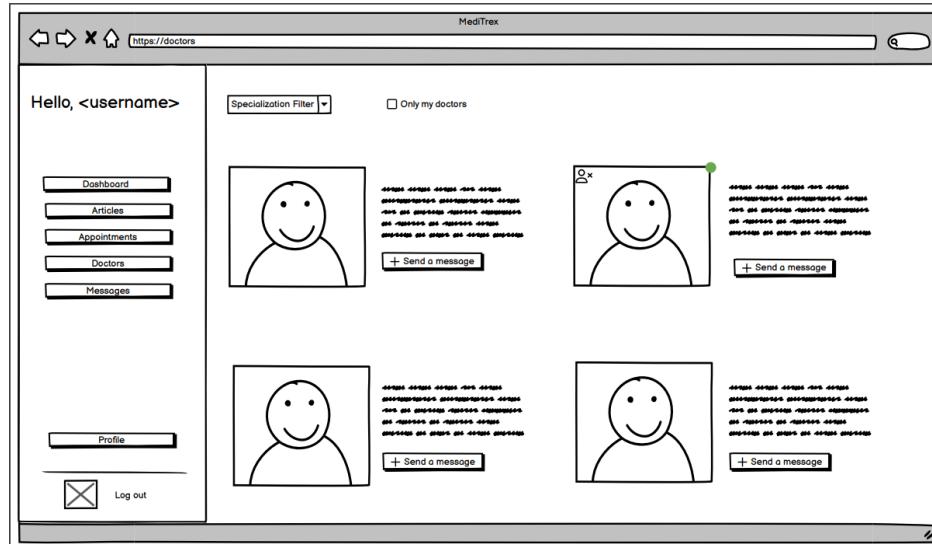


Figure 9: Doctor's list

As a Patient I want to send a request to a doctor so that I can start chatting with them.

As a Patient I want to communicate with my GP and any specialist I follow so that I can ask questions and report concerns.

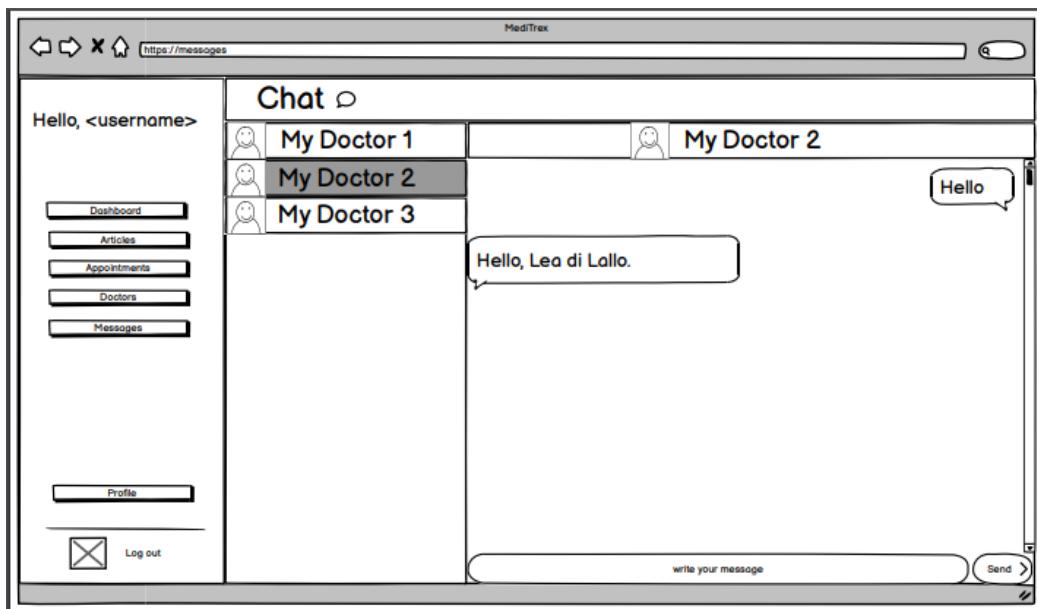


Figure 10: Chat - Patient's side

As a Patient I want to view my complete medical record, including medical history and allergies.

The wireframe shows a web page titled 'A Web Page' with the URL 'https://medical_record'. The left sidebar, labeled 'Hello, <username>', contains links for Dashboard, Articles, Appointments, Doctors, Messages, Profile, and Log out. The main content area is titled 'Medical Record' and displays a placeholder profile picture for 'Lea di Lallo' (10 giugno 1999). Below this, there are sections for 'Malattie Pregresse' (Past illnesses) with two rows of wavy lines and three checkboxes for 'yes', 'no', and 'occasionally'. A 'Save' button is located at the bottom right.

Figure 11: Patient Medical Record

2.1.2 Doctor Section

As a GP I want to access my Dashboard so that I can prescribe medications for my patients.

As a doctor (either specialized or GP) I want to access my calendar so that I can view and manage my upcoming appointments with my patients.

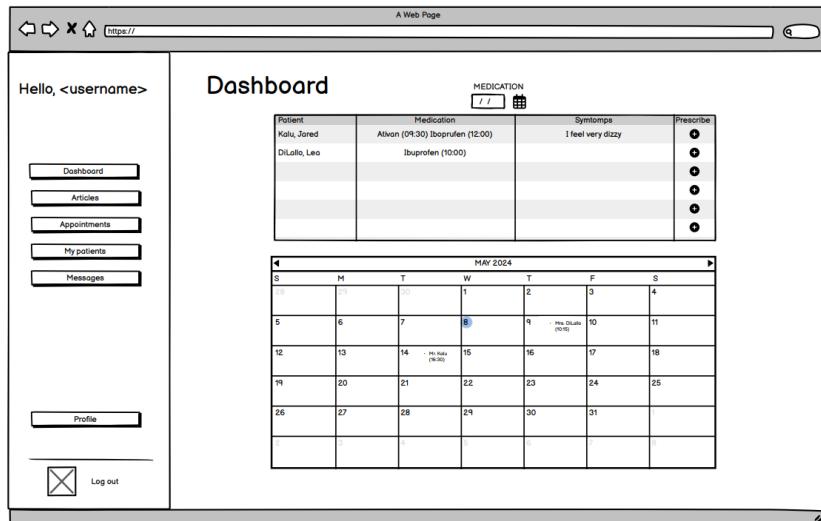


Figure 12: Dashboard - Doctor's side

- As a Doctor, I want to be able to see my patients, so that I can keep track of them.
- As a GP I want to access my patient page so that I can view their medical records.
- As a specialized doctor I want to review my patient medical records so that I have a comprehensive understanding of their medical histories.

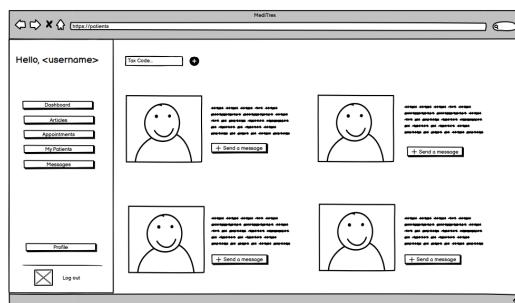


Figure 13: List of patients



Figure 14: Patient's medical record

As a GP I want to accept my patient requests so that I can add new patients.

As a GP I want to access my messages so that I can chat with my patients.

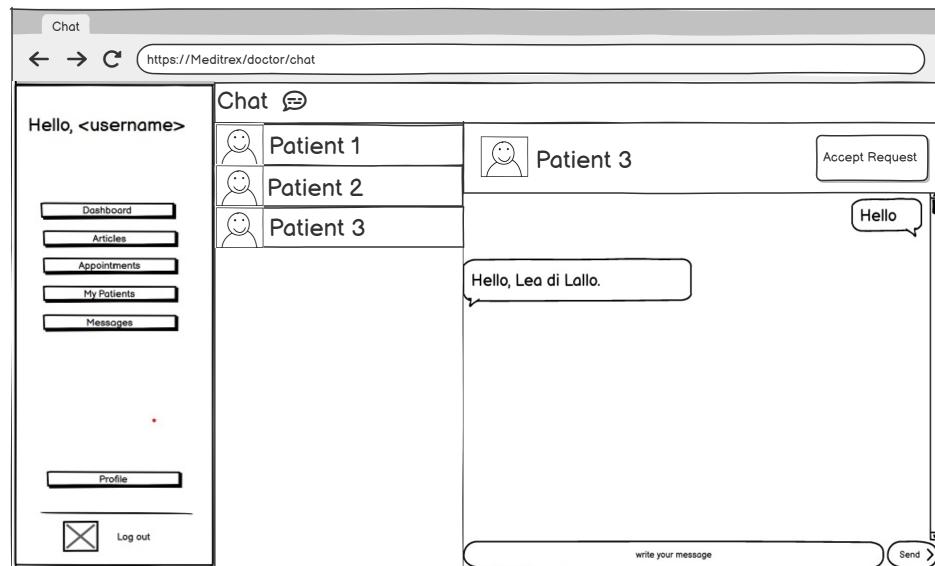


Figure 15: Chat between Doctor and Patient

2.2 Function Points

To estimate a functional size measurement of MediTrex, Function Points have been calculated. Firstly, database's entities have been considered as ILF (Internal Logical Files). Then, among all the user stories, EI (External Inputs), EO (External Outputs) and EQ (External Inquiry) have been evaluated. Hereafter, a table that reports all the calculated Function Points.

No.	Module	Function Name	Description	Type	DET	RET / FTR	Complexity	FP
1	Entity	Specialties	Signing-Up as Doctor/Patient	ILF	3	1	Low	7
2	Entity	Prescriptions	Sign-In as Doctor/Patient and Logout	ILF	8	1	Low	7
3	Entity	Messages	Users can read some main articles by accessing the homepage	ILF	5	1	Low	7
4	Entity	Users	Users can see more articles by accessing a dedicated page	ILF	13	1	Low	7
5	Entity	TakenPrescriptions	Patients can see their prescriptions and symptoms by accessing their dashboard	ILF	6	1	Low	7
6	Entity	InTreatment	Patients can see and manage their medical history and allergies by accessing their medical record	ILF	5	1	Low	7
7	Entity	Symptoms	Patients can see doctor list with all the expertise information that doctors can edit in their own	ILF	4	1	Low	7
8	Entity	Appointments	Patients can add some doctors and start chatting with them	ILF	6	1	Low	7
9	Entity	MedicalRecord	Patients can send a doctor a request for them to become their GP	ILF	8	1	Low	7
10	General Setup	Sign-Up	Signing-Up as Doctor/Patient	EI	13	2	Average	4
11	General Setup	Sign-In	Sign-In as Doctor/Patient	EI	2	1	Low	3
12	General Setup	Logout	Logout	EI	1	1	Low	3
13	General Setup	Main articles	Users can read some main articles by accessing the homepage	EQ	6	1	Low	3
14	General Setup	Article page	Users can see more articles by accessing a dedicated page	EQ	6	1	Low	3
15	Personal Area	Patient Dashboard	Patients can see their prescriptions and symptoms by accessing their dashboard	EQ	9	3	Average	4
16	Personal Area	Patient Dashboard	Patients can manage their symptoms by accessing their medical record	EI	2	1	Low	3
17	Personal Area	Medical Record	Patients can see their medical history and allergies by accessing their medical record	EQ	16	5	High	6
18	Personal Area	Medical Record	Patients can manage their medical history and allergies by accessing their medical record	EI	6	2	Average	4
19	Personal Area	Doctor List	Patients can see doctor list with all the expertise information	EO	8	3	Average	5
20	Personal Area	Doctor Profile	Doctors can manage their own profile	EI	3	1	Low	3
20	Treatment Management	Patient-Doctor Communication	Patients can start chatting with doctors	EI	5	1	Low	3
21	Treatment Management	GP request	Patients can send a doctor a request for them to become their GP	EI	3	1	Low	3

Figure 16: Function Points table

So, summing all the single values, 110 unadjusted function points were obtained and this leads to 8800 SLOC (source lines of code).

3 Development

To guarantee an efficient development of the entire app, SCRUM method has been used to self-organise and manage the workload towards a common goal through a set of values, principles, and practices. The whole work has required three sprints, each one focusing on a macro-functionality:

- **General Setup:** this sprint implements the main functionalities of an account both for doctors and patients, such as sign-up, sign-in, log-out. Users can also read main articles by accessing the homepage or the Article page.
- **Personal Area:** this sprint implements the core functionality of the app, the personal area. A patient can see their prescriptions and symptoms by accessing their dashboard, manage their medical histories and allergies by accessing their medical record, can see doctor list with all their expertise information that doctors can edit in their own profiles. Moreover, a patient can add some doctors and start chatting with them. On the other hand, a doctor can access their dashboard and prescribe medications to their patients.
- **Treatment Management:** this sprint implements the functionality that permits a patient or a doctor to manage the treatments between them. Patients can send doctors a request for them to become their GP, Doctors and GPs can manage their own patients' prescriptions, Patients can access a calendar and check their appointments, Doctors can access a calendar and manage their appointments.

The whole development lasted six weeks, taking the team 160 hours of work.

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

Figure 17: SCRUM sprints

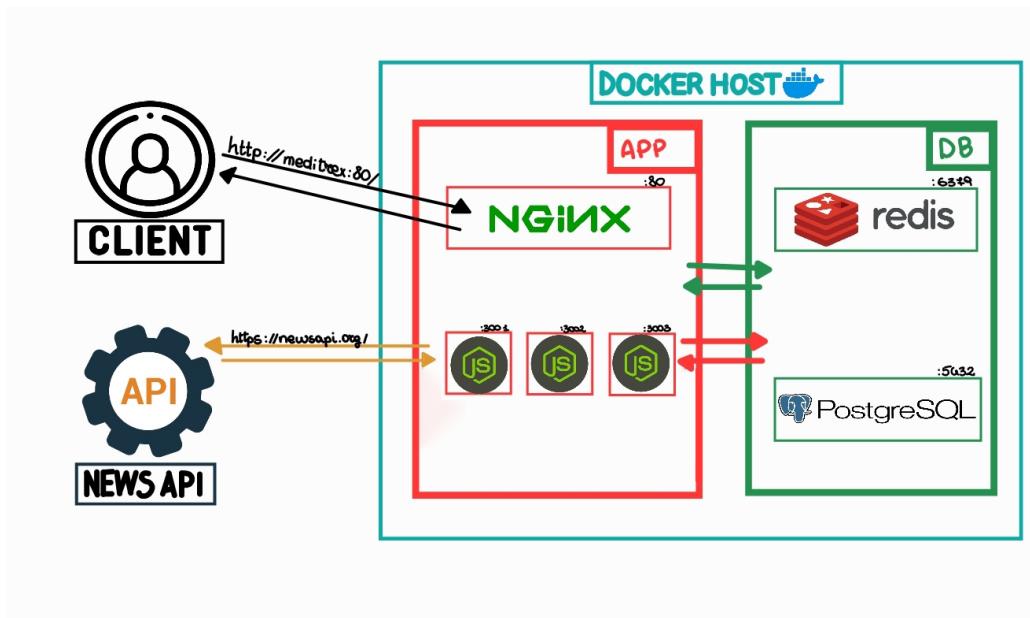
4 The architecture

MediTrex is built on a distributed approach to overcome the limitation of centralized environment.

Docker has been chosen to reach more portability and coherence among all the environments. It's a containerization tool that allows to pack the app and all its dependencies in an isolated environment. There were used 6 containers.

As runtime environment, **NodeJS** has been chosen. It has been replicated on three nodes to guarantee the availability and the reliability of the system. Then, to create a "connection" between the various NodeJS instances, **Redis** has been used.

Moreover, **Postgres** has been chosen for the data persistence and **nginx** has been chosen as proxy server for the load balancing.



Finally:

- to **detect potential** errors or down statuses of containers, it has been used the failure detection technology, a software module used to detect

faulty processes;

- due to the necessity of notifying patients about information from their doctors, a **Broadcast Communication Network** has been used. This network gets messages from a single sender and transmits them to all the endpoints on the network;
- to avoid issues during the registration process, it has been used a **Consensus primitive**, in cases where different users attempt to sign up with the same data.

5 Feature Overview

In this section, the main features will be shown.

- When the app starts, Homepage is shown. It contains an introduction to the app and some main articles.

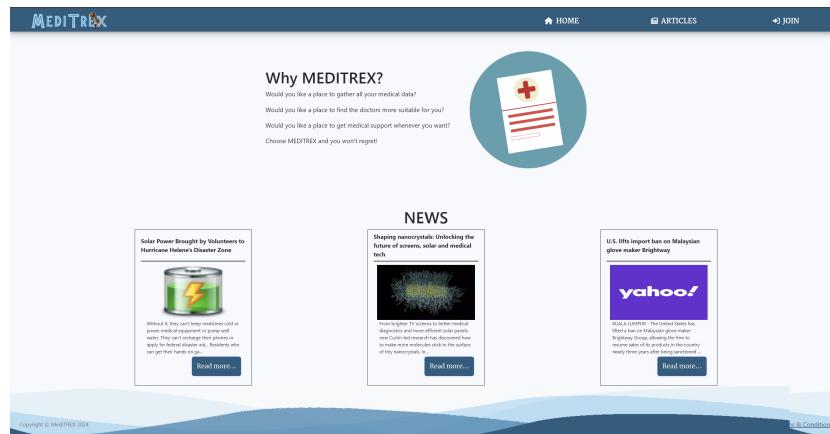


Figure 18: Homepage

- Through the navbar, it is possible to access various sections, including the article page, to allow any visitor to consult the latest news in the medical field.

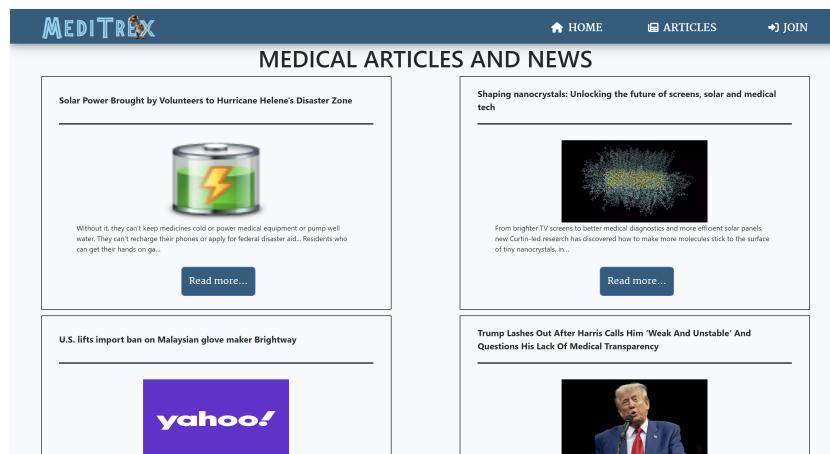
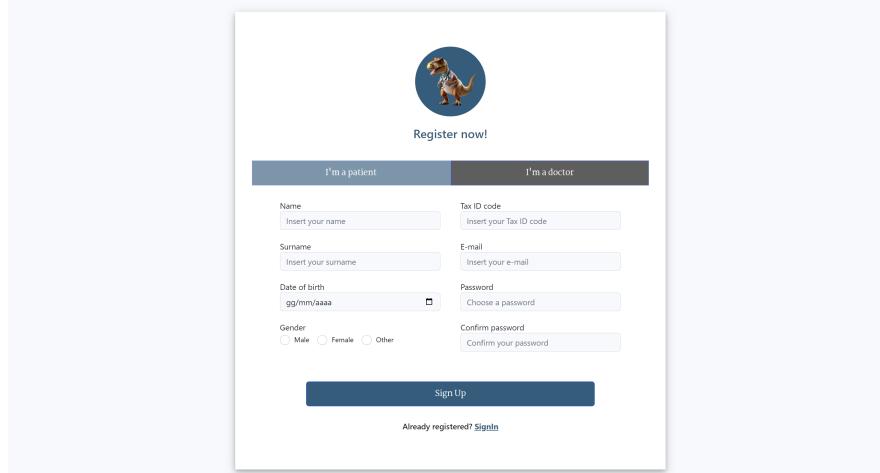


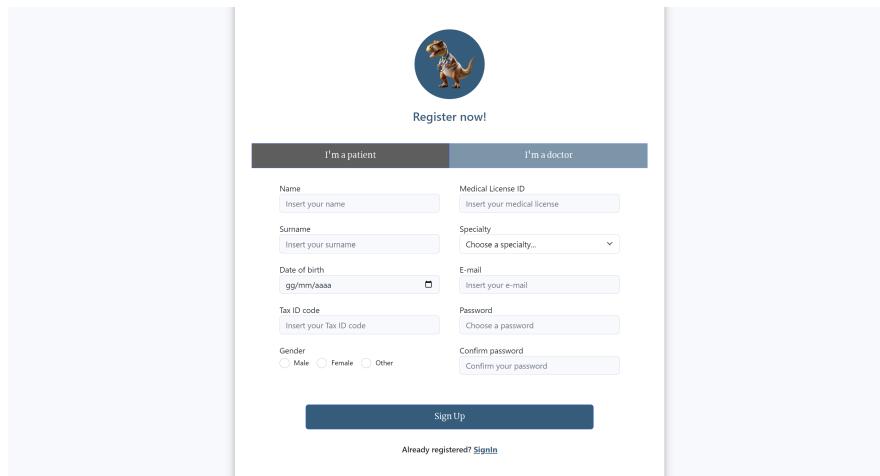
Figure 19: Article page

- Then there is the Sign-Up section, that allows visitors to create an account to access the features of MediTrex. Patients are asked to insert only basic information. Doctors instead are asked to insert also their Medical License IDs and their specialties.



The screenshot shows the Patient Sign-Up page. At the top center is a circular logo featuring a cartoon dino-like character. Below it is the text "Register now!". There are two buttons at the top: "I'm a patient" (highlighted in blue) and "I'm a doctor". The "I'm a patient" section contains fields for Name (with placeholder "Insert your name"), Surname (placeholder "Insert your surname"), Date of birth (placeholder "gg/mm/aaaa"), and Gender (radio buttons for Male, Female, Other). The "I'm a doctor" section contains fields for Tax ID code (placeholder "Insert your Tax ID code"), E-mail (placeholder "Insert your e-mail"), Password (placeholder "Choose a password"), Confirm password (placeholder "Confirm your password"), and Medical License ID (placeholder "Insert your medical license"). At the bottom is a "Sign Up" button and a link "Already registered? [SignIn](#)".

Figure 20: Sign-Up as a Patient



The screenshot shows the Doctor Sign-Up page, which is similar to the Patient version but includes additional fields. The "I'm a doctor" section now includes a "Specialty" dropdown menu (placeholder "Choose a specialty...") and a "Tax ID code" field (placeholder "Insert your Tax ID code"). All other fields and layout remain the same as the Patient sign-up page.

Figure 21: Sign-Up as a Doctor

- If a user is already registered, they can log in using an appropriate section, shown in the following figure:

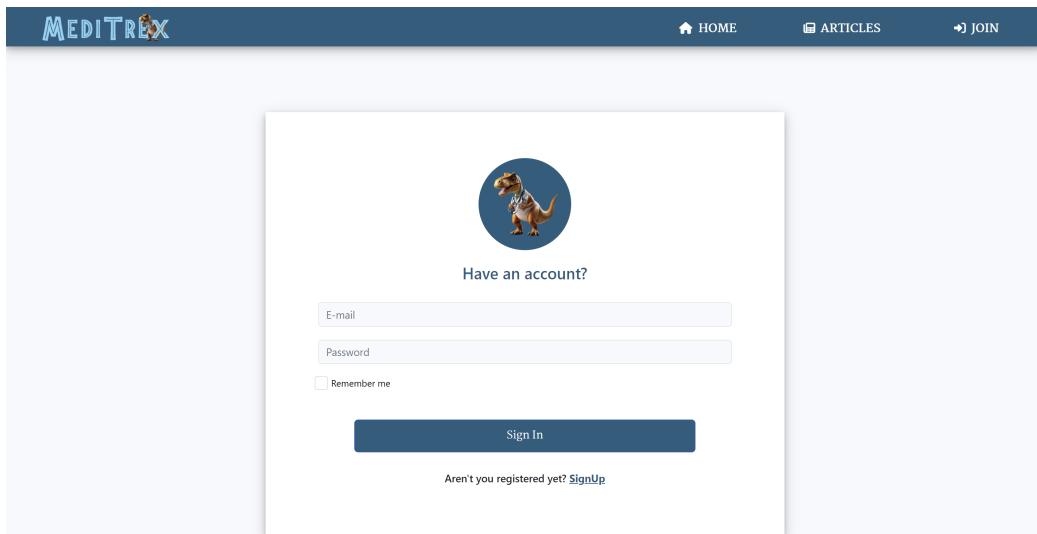


Figure 22: Sign-In

5.1 Doctor's section

- Once a user has logged in as a doctor, the first page displayed will be the dashboard. It contains a list of their patients, with some relevant information, to allow the doctors to prescribe a medication, and their calendar to see or manage an appointment.

The screenshot shows the Doctor's Dashboard. On the left is a dark sidebar with a user profile picture and the name "Giulia". The main area is titled "DASHBOARD". It features a table of patients:

Patient	Medications	Symptoms	Prescribe	
Samuele Cervo			<input type="button" value="⊕"/>	
Rosapia Laudati			<input type="button" value="⊕"/>	
Luigi Verdi	<input checked="" type="checkbox"/> Nurofen (1000 2/d) <input checked="" type="radio"/>	<input checked="" type="checkbox"/> Nurofen (1000 2/d) <input checked="" type="radio"/>	Cold and Headache	<input type="button" value="⊕"/>

Below the table is a calendar for October 2024, showing days from Sunday to Saturday.

Figure 23: Doctor's Dashboard

The screenshot shows the Doctor's Dashboard with a "New Prescription" dialog box open over the patient list. The dialog contains fields for Patient (Luigi Verdi), Medication (Nurofen), Starting date (15/10/2024), Ending date (22/10/2024), Intake (Twice a day), and Time (10:00). A "Save prescription" button is at the bottom.

Figure 24: New Prescription

- Through the calendar, a doctor is able to add a new appointment.

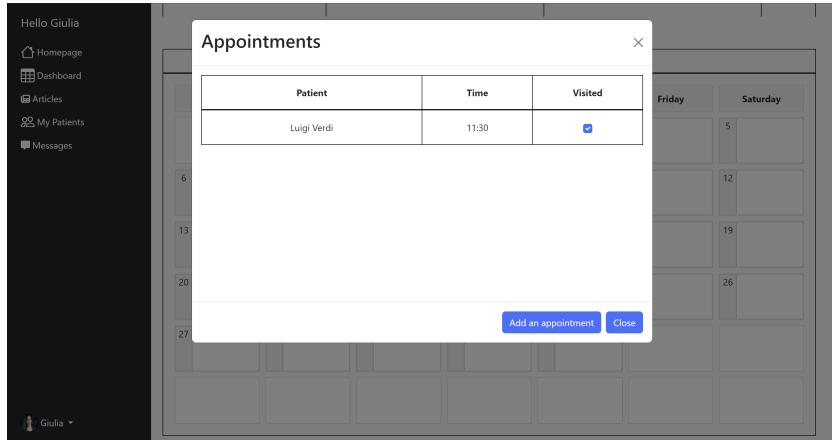


Figure 25: Add an appointment

- Then, a doctor can access the list of their patients via the appropriate section *My Patients*. This page shows the patient cards, from which doctors can access their patients' medical records, contact them or remove them from the list. Furthermore, in this section the doctor can accept pending requests from new patients.

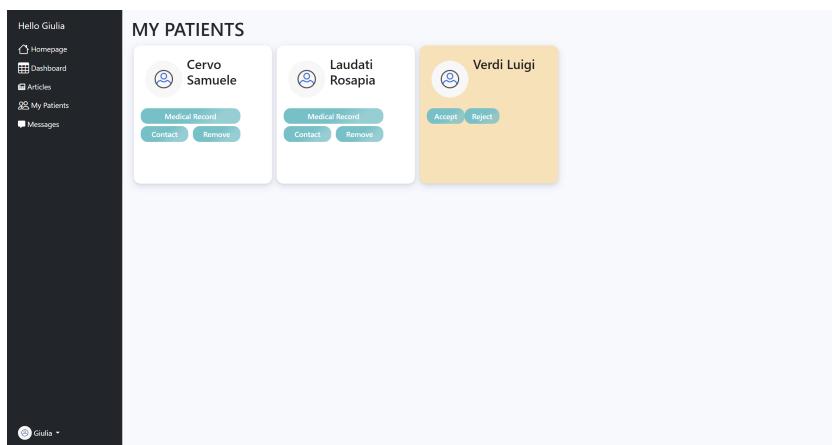


Figure 26: List of patients

- The medical record of a selected patient, shown in the following figure, contains various information including their medical history, their prescriptions, etc...

MEDICAL RECORD

Name: Laudati Rosapia

Gender: F

GP Name: The patient hasn't requested a GP yet.

Email: rosapia@meditrex.it

Medical History: Cardiac Disease

Current Symptoms:

Allergies: Dust, Pet

PRESCRIPTIONS

Gender: F

GP Name: The patient hasn't requested a GP yet.

Email: rosapia@meditrex.it

Current Symptoms:

Allergies: Dust, Pet

PRESCRIPTIONS

From: 2024-06-18
To: 2024-07-15

- Medicine: Augmentin
- Frequency: 2/d
- Doctor: Giulia Rossi

Figure 27: Medical Record

- Through a patient's card, or through the specific *Messages* section, a doctor can communicate news to all their patients via a special broadcast channel, or communicate with a specific patient via the dedicated chat. Furthermore, even in this section it is possible to accept new patients. All these features are shown in the following figure.



Figure 28: Doctor's chat

- A Doctor can access their own profile and change their own bio, photo and password.

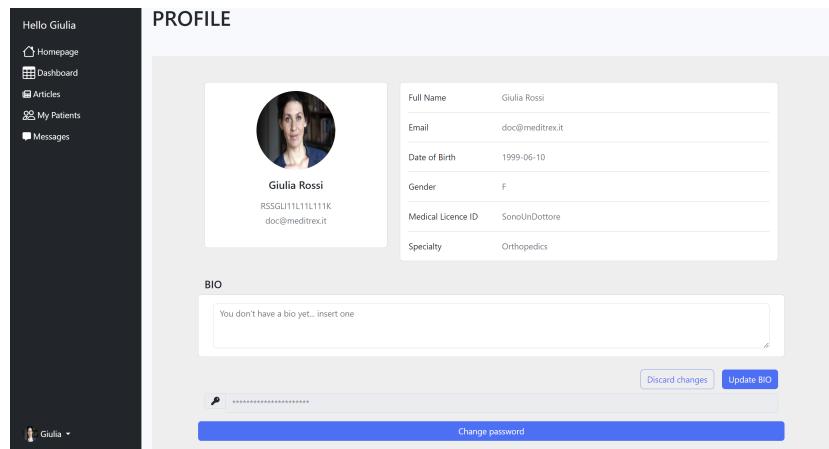
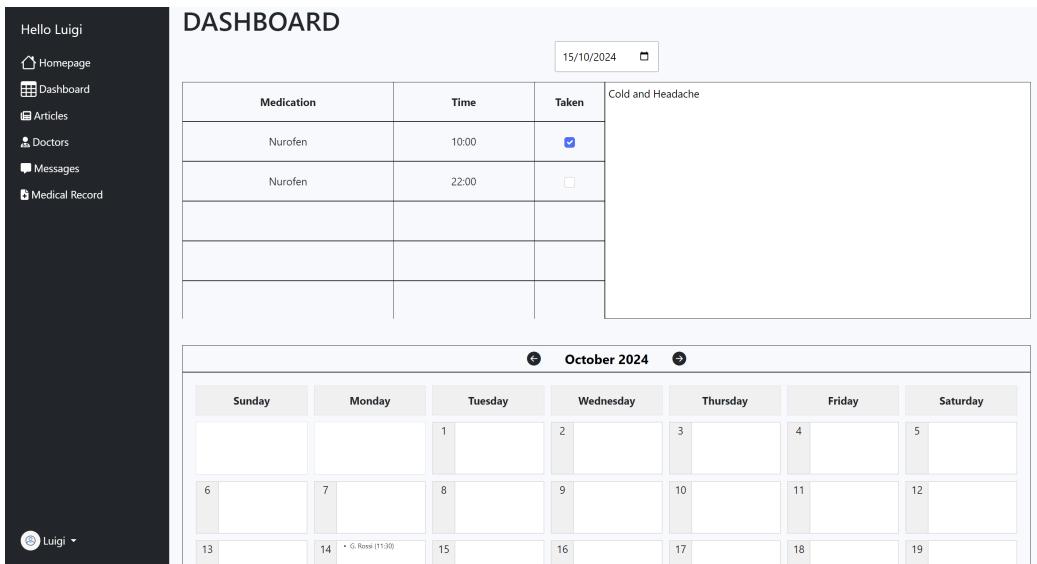


Figure 29: Doctor's Profile

5.2 Patient's section

- Once a user has logged in as a patient, the first page displayed will be the dashboard. It contains the list of medications, a text section where they can write to keep track of their symptoms, and a calendar where they can see the appointments with their doctors.



The screenshot shows the Patient's Dashboard interface. On the left, a dark sidebar displays a 'Hello Luigi' greeting and navigation links: Homepage, Dashboard, Articles, Doctors, Messages, and Medical Record. A user profile icon 'Luigi' is at the bottom. The main area is titled 'DASHBOARD' and shows the date '15/10/2024'. Below this is a table for medication tracking:

Medication	Time	Taken	Cold and Headache
Nurofen	10:00	<input checked="" type="checkbox"/>	
Nurofen	22:00	<input type="checkbox"/>	

Below the table is a monthly calendar for October 2024, showing days from Sunday to Saturday. Specific dates like 'G Rest (11:30)' on Monday, October 14th, are highlighted.

Figure 30: Patient's Dashboard

- A patient can access their medical record where they can manage or add their personal information and where they can view their prescriptions.

MEDICAL RECORD

Name: Luigi Verdi

Gender: M

GP Name: You haven't requested a GP yet.

Email: pati@meditrex.it

Medical History: Diabetes

Current Symptoms:

Allergies: Nickel

Habits:

Smoke: Never Occasionally ≤ 3 times a day > 3 times a day

Drugs: Never Occasionally ≤ 3 times a day > 3 times a day

Alcohol: Never Occasionally ≤ 3 times a day > 3 times a day

Save

PREScriptions

From: 2024-06-18
To: 2024-07-15

- Medicine: Paracetamol
- Frequency: 2/d
- Doctor: Giulia Rossi

Save

Figure 31: Medical Record

- Then, a patient can see the list of doctors and their bios and specialties. Here, a patient can contact a doctor and ask them to become their own GP.

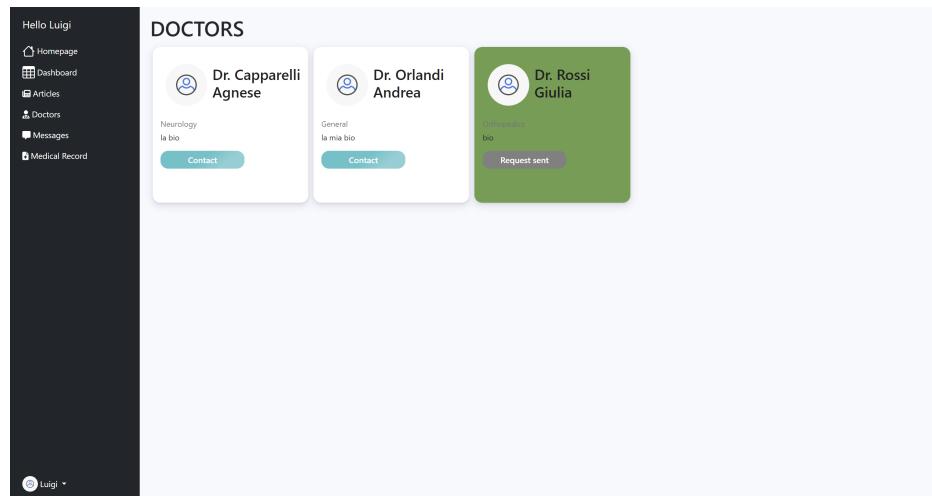


Figure 32: Doctor cards

- Every patient can message with their doctors in their Chat page and they also can read messages sent by doctors in their broadcast chat.

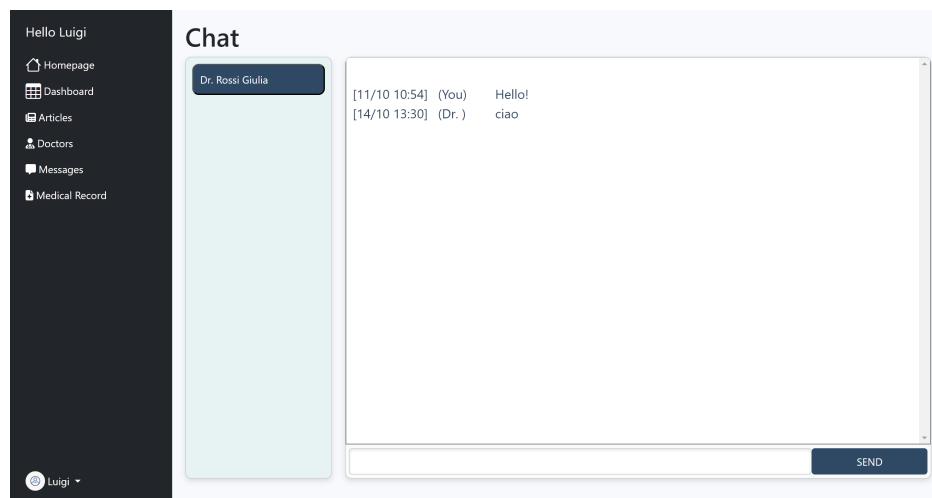


Figure 33: Patient's chat

- A patient can access their own profile and change their own photo and password.

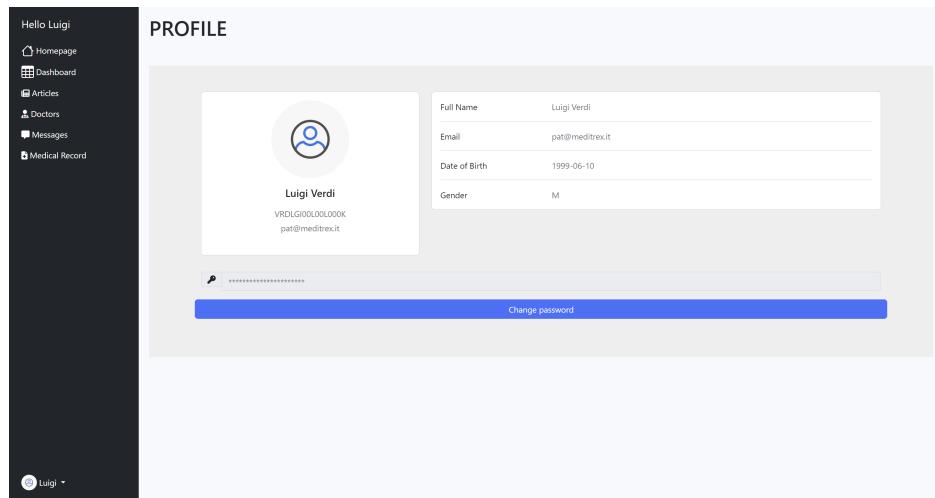


Figure 34: Patient's profile

6 Conclusions

MediTrex is an app created to make it easier for people of any age to manage their daily health necessities. It acts as an online medical journal and a communication tool, simplifying connections between patients and doctors. To reach its full potential, MediTrex should constantly evolve to overcome its limitations.

Continuous development, thorough testing and feedback from real-world users, are essential for improving the application to meet healthcare standards.