IO3 REPORT

PILOTING THE PROLEPSIS MOBILE APPLICATION AND THE ADMINISTRATIVE PLATFORM

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WWW.PROLEPSIS.EU

This report was developed in the framework of the Erasmus+ Prolepsis[1] partnership, under the leadership of Cyprus University of Technology (CUT).

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[1]To learn more: https://prolepsis.eu

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Introduction

SLG, as the technical partner of the consortium has designed, with the help of the other partners of the consortium, align with the primary specification and requirements, based on the proposal and developed the mobile application of "PROLEPSIS", available for iOS and ANDROID mobiles, as well as the administrative platform.

The content of the mobile phone-based health intervention is managed and updated from the administrative platform. It aims and is used as a means to enhance preventive health care behaviour among informal carers' population and with a perspective of potential other groups of women. It is personalised with tailored individual messages, aspiring to educate and enrich their knowledge and health literacy on breast cancer through thematic modules, articles and videos and promote practices, such as BC screening, breast self-examination, mammography, MRI and to encourage them in behavior that will lead to an early detection of breast cancer.

The objective of this document is to present in a synoptic way the design and the development of the Prolepsis Administrative Platform and the Mobile Application, and how it has been formed, configured and colored, in its essence, after the internal testing and more important, after pilot period and the improvements that the end users have indicated, with the help and guidance of the partners that lead the pilots. All the functionalities and the roles that can be found in Prolepsis, are outlined, enriched with all the improved functionalities, as well as some new additions. The architecture is described, along with the technologies used.

In the appendix section, the final version of the PROLEPSIS is available through the manuals that offer an analytical presentation with detailed instructions of the Prolepsis Administrative Platform and the Prolepsis Mobile Application (Appendix II).

Within the Mobile App, a help video (Appendix I) is available showing the use of the Mobile App.

The Roles of the Prolepsis Platform

- Super Administrator > Users with this role will access the web part.
- Region Administrator > Users with this role will access the web part (new role)

The role of the Prolepsis Mobile Application (for iOS & ANDROID devices)

- Carers – End users -> Users with this role will access the mobile application.

Prolepsis : Visioning the Idea

REQUIREMENTS DERIVATION & SPECIFICATION

At the beginning of this phase, the primary vision of the project was presented to the first meeting. It was based on the following:

- The Content Management System (CMS) that would be the foundation of the structure. The CMS would be used to create, categorize and publish the content.
- The Mobile Application for iOS & ANDROID, which would retrieve from the CMS and present the content, along with other functionalities.

In the graphic below (Mobile App: Registration Phase), the first idea was presented.

The Carer – end user of the Mobile App would create an account to login at the mobile app.

The mobile app would be a tool for informal carers to reinforce positive behaviors and encourage the use of regular preventive services in the context of early detection of breast cancer.

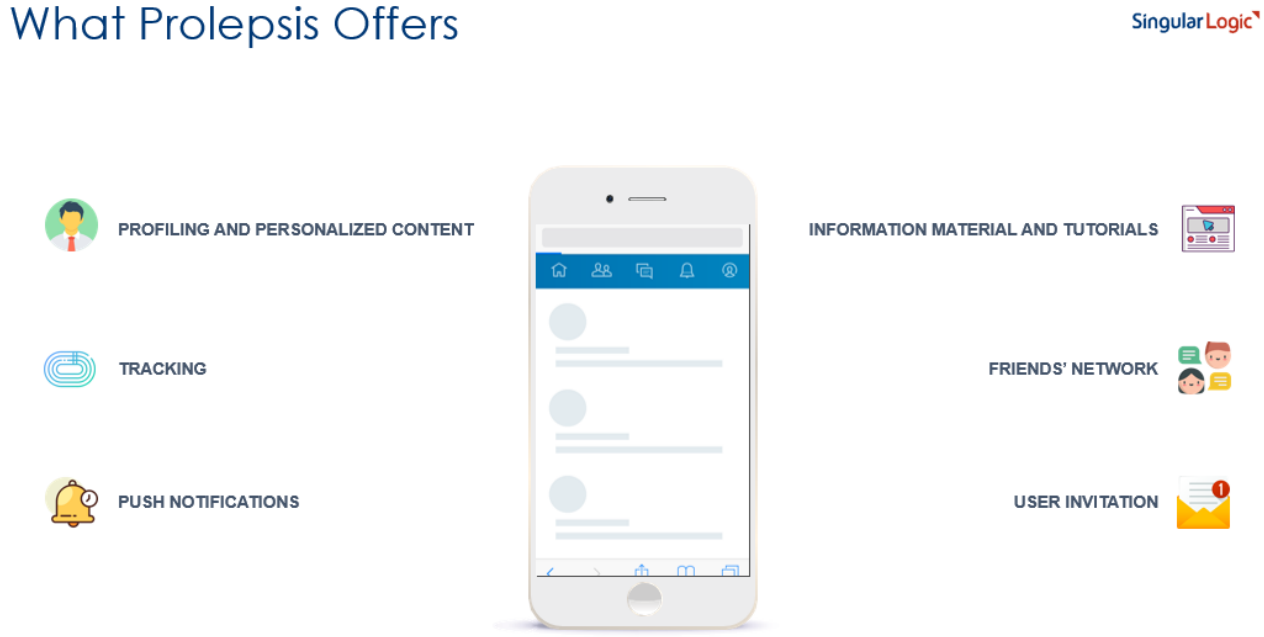
The objectives would be to:

Be informed - Search and be informed through a rich database of articles and videos.

Keep Track - Keep track of breast medical history, upcoming appointments and menstrual cycle.

Motivate - "Be there for your loved ones". Motivated with reminders for prescheduled examinations and breast self-examinations etc.

The following diagram (*What Prolepsis Offers*) presents the required functionalities of the mobile app.



The Prolepsis mobile application was aiming to motivate the informal carers to:

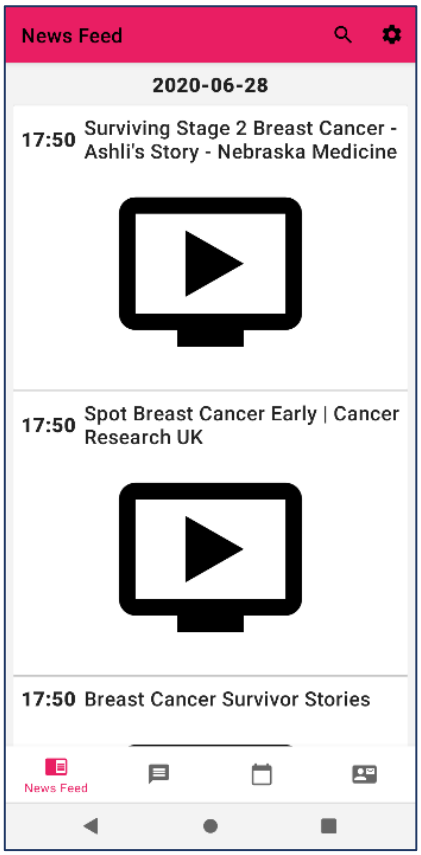
- Take care of their own self
- Adopt Proactive & Positive Behavior
- Proceed to Preventive Health Actions
- Be informed
- Keep track of breast medical history & menstrual cycle
- Remember upcoming appointments

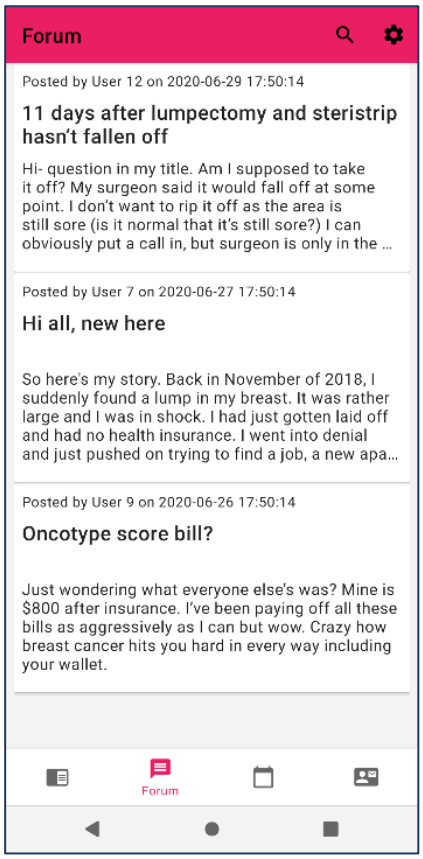
- Mutual Support
- An early detection of breast cancer

During this phase all the partners shared their thoughts and opinion. Ideas of functionalities that could be offered in each factor were on the table and discussed. The strengths were analysed, the difficulties and restrains were opposed, as well as limitations and weaknesses from the GDPR aspect and the technology.

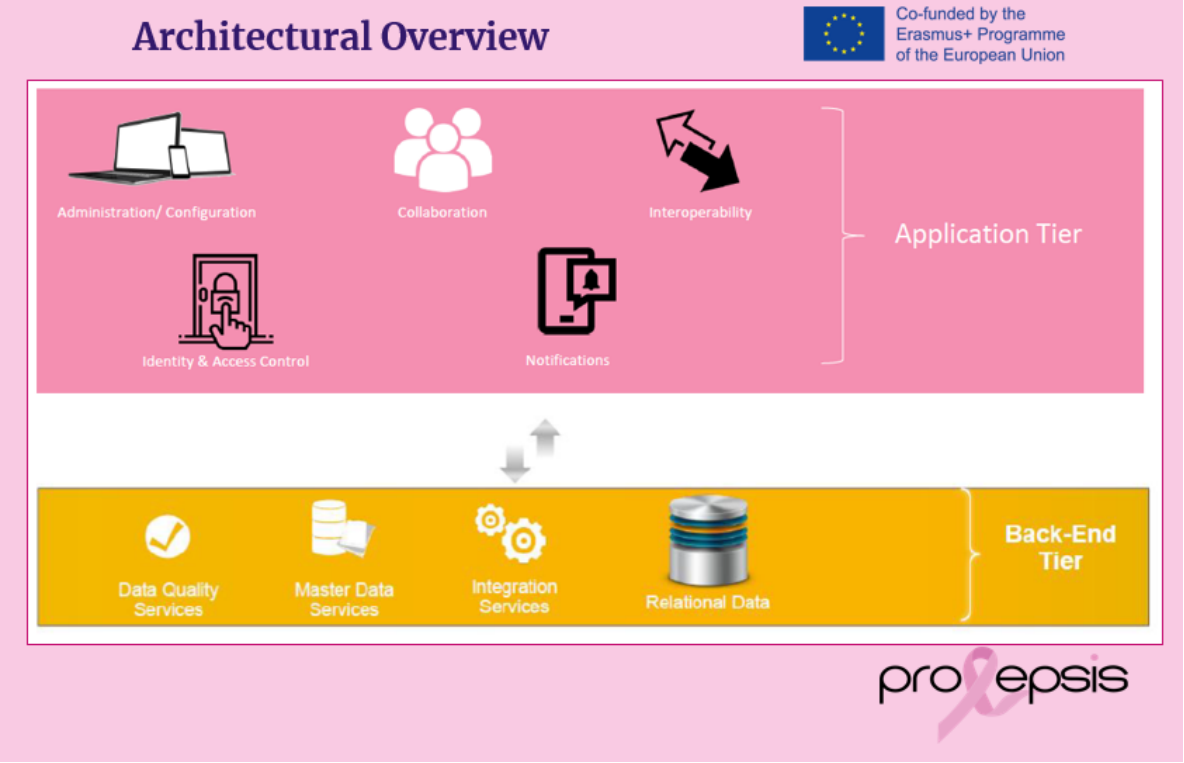
The theoretical basis were set and started to build the foundation, at the same time that the partners were researching and evolving the structure of the modules and the content.

At the following figure some of the primary mobile app mock ups are shown:





The Architectural overview



In the above figure the architectural overview is depicted in a diagram. Regarding the foundation, the back end and the front end were developed. The front end is actually the administrative platform from where the content is managed.

The designing and development of the prototype was the main objective and target for SingularLogic that was leading the IO3.

The usual path to succeed this target is to follow certain steps, in certain order, as listed:

- ✓ Set up the concept & architectural design
- ✓ Build the individual services based on the user requirements
- ✓ Design & Develop first prototype
- ✓ Amendments based on received pilots' feedback
- ✓ Fine tuning & deliver of the final version

The above steps are depicted in a diagram in the following Figure 1.

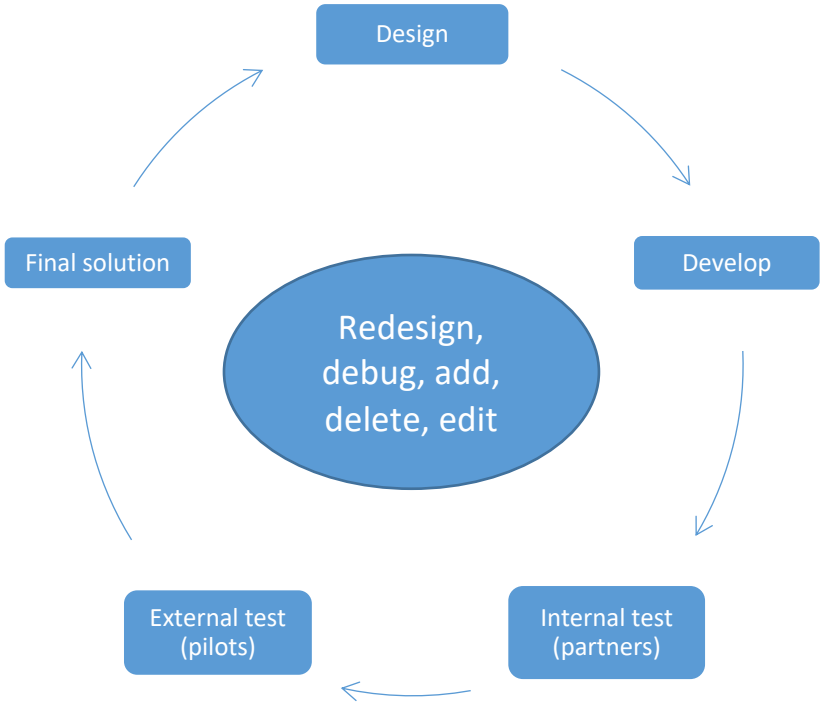
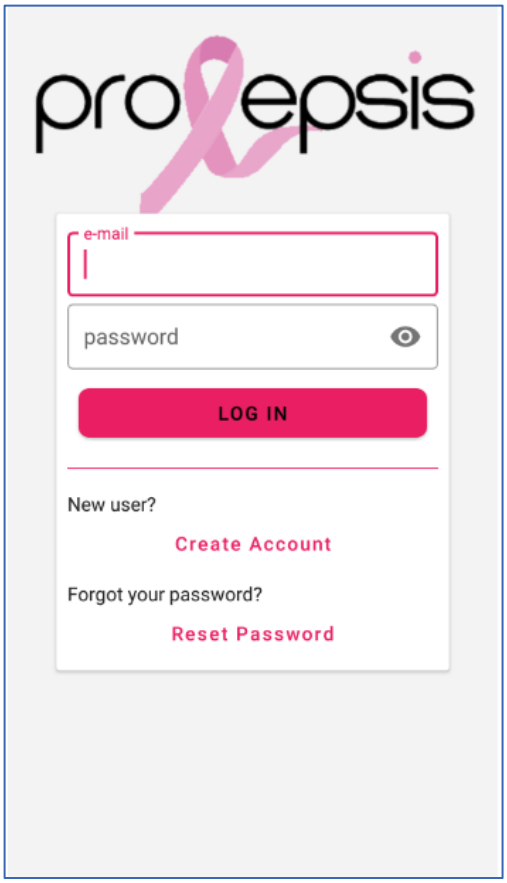


Figure 1: Diagram of the designed steps and development of prolepsis mobile app.

Chapter 1: The Mobile Application

1.1 DESIGN OF THE MOBILE APPLICATION PROTOTYPE



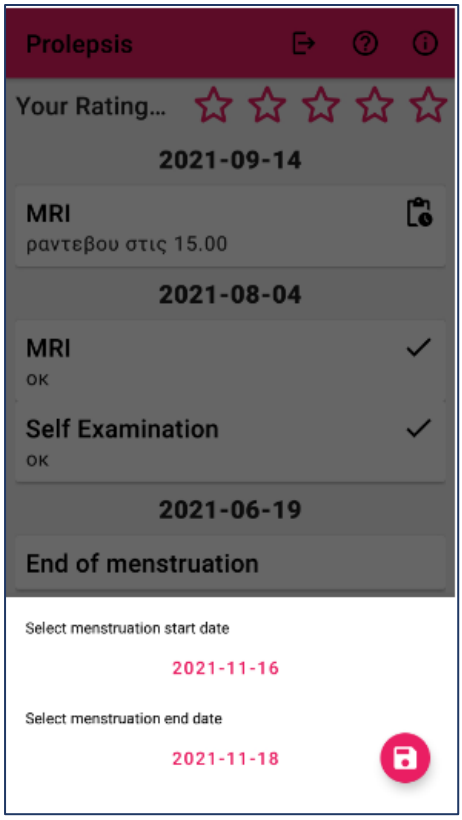
The initial prototype was designed as per the specifications. It contained three layouts and a bottom navigation bar. There was one screen for articles and videos, one screen for a forum (where the users could send eponymously or anonymously messages and they could be answered by professionals), and one that contained their medical history. Actually, creating an account was optional and if the user decided to use the application anonymously it precluded them from using the medical history page. For those that created an account a questionnaire would be shown which, if answered, would categorize the users into different risk factors, in order for them to receive different customized content for their category.

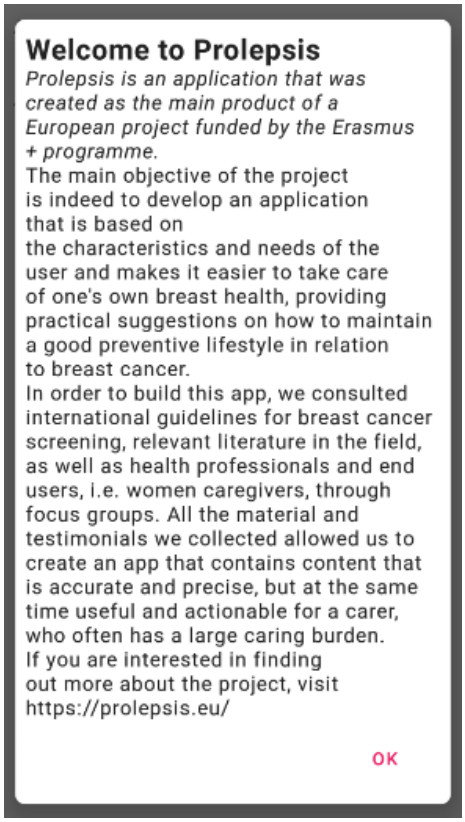
It was designed as multiple interconnected screens on a layout editor so the users could see how they could interact with the final product without having to actually implement any of the code needed to make the application work.

At the end of the prototype phase, it was decided to split the videos and articles screen into two different screens, replace the forum with a group chat (for fear that it could be abused and false information could be spread) controlled by the chat's initiator, and have the medical history also contain menstruation cycle logging as well as a rating system to keep users motivated.

The article and videos screen would be open to all users but in order to use the chat and history features one would need an account. Furthermore, to avoid creating incorrect impressions the results of answering the questionnaire were hidden, but the user would still receive custom content according to their risk factor.

1.2. DEVELOPMENT OF THE MOBILE APPLICATION





ANDROID DEVICES

The application was initially developed for android mobile devices and later on ported to iOS. For the android application the MVI architecture was used. Initially a storyboard was drawn that represented the final product and was the basis for development.

For the User Interface (UI), Google's Material design, Paging Library and BumpTech's Glide were used to create the screens as designed during the prototyping stage. Google's Navigation Api was used to implement the designed storyboard and connections between the different screens. SquareUp's retrofit and moshi libraries were used to handle the Network layer's requests. Google's Firebase was used to receive messages from the backend server, such as reminders for upcoming exams, motivational messages or information the user may be interested in according to their risk factor. It was decided that the application would only work online so no persistence library was used to save or cache data.

The data that the application required to use to work (settings, tokens etc) would be stored internally. Provisions were made for different translations, by incorporating a scheme where each network request would have a locale attached to it, so the backend server would know in what language the request was made. For the actual application a file was created with all the English translations, which would later be filled in for other languages.

At this point the partners were given access to test and comment on the application. During this stage, it was also decided that articles would also act as modules, i.e. a grouping of different articles that the user would have to read in order to be considered as having finished the module. After finishing this stage, the port to iOS started.

iOS DEVICES

During the development of the iOS app, the developers used the Model View Controller (MVC) design pattern. This means that there are structures that act as Models, the Views are in charge of the User Interface (UI) experience and the Controllers have all the logic for updating the UI.

In order to maximize impact and reach the full operational potential, the Apple Human Interface Guidelines (AHIG) was, from day one, the main resource for designing the iOS app.

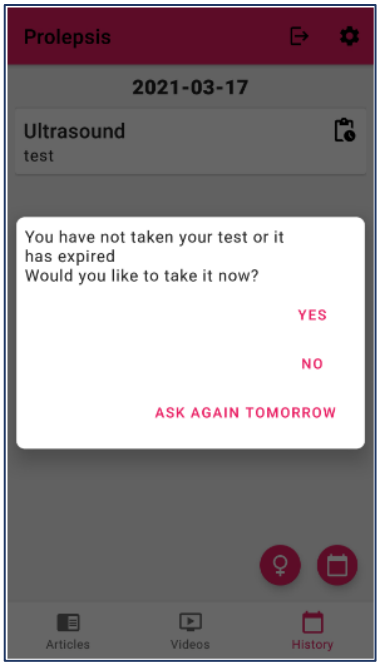
As with the Android version, the iOS app does not save or cache any sensitive user information. Any data that are required for authentication (tokens), messaging or updating some app UI elements are stored in the device's keychain.
Keychain is a specialized database for storing metadata and sensitive information, because all of the data is stored on the device with strong encryption.

At the end of this stage a fully working application was delivered in English ready for the different localizations

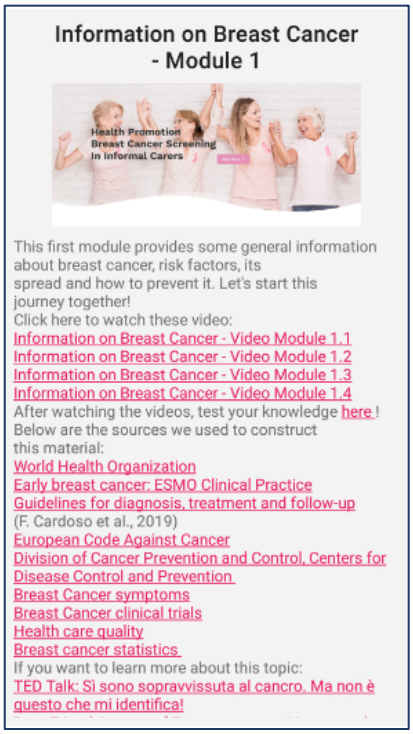
1.3 Functionalities and operation of the services of the Mobile Application

The services that the Prolepsis Mobile Application provides are:

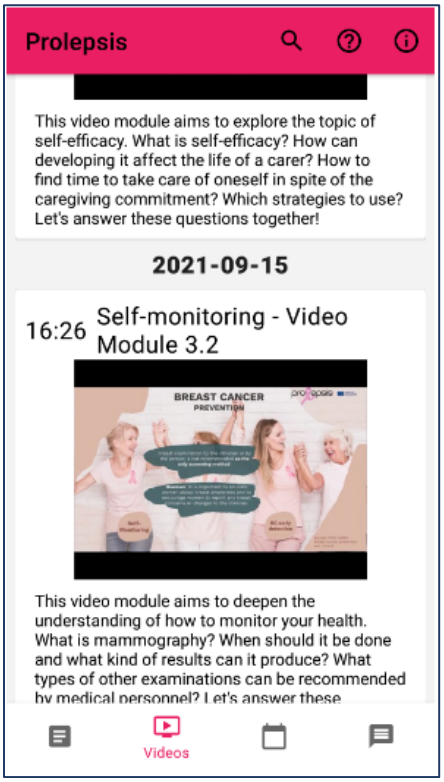
- **Initial Assessment**. It appears after the login and can be answered at any time that is suitable. By answering the Initial assessment, the users are automatically categorised as low risk, medium risk and high risk. The results are not shown to the users, however they are used to personalise the operation of the mobile, as it sends personalised messages and presents articles and videos according to the risk category. The "general" category is for all categories and shows also if the user has not answered the initial assessment.

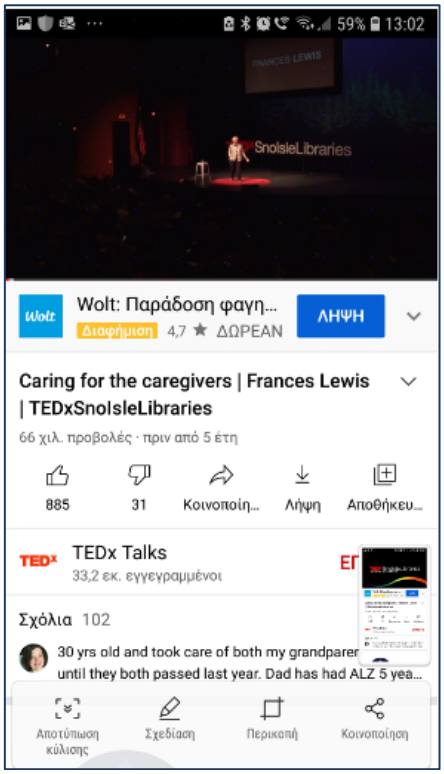


- **Articles.** Articles and Modules with specific thematic and completed with articles, quizzes and videos, are listed so as to be selected and open.

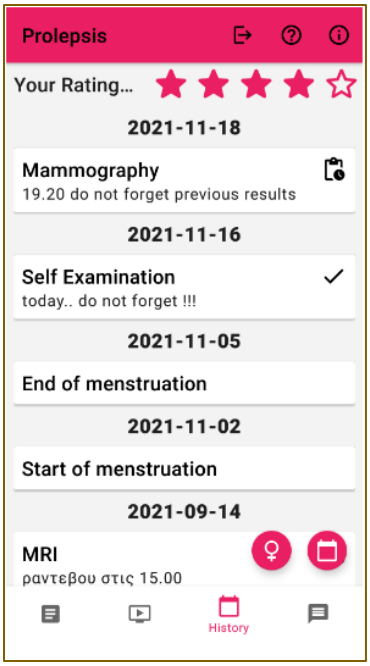


- **Videos.** Videos are listed to select and watch.

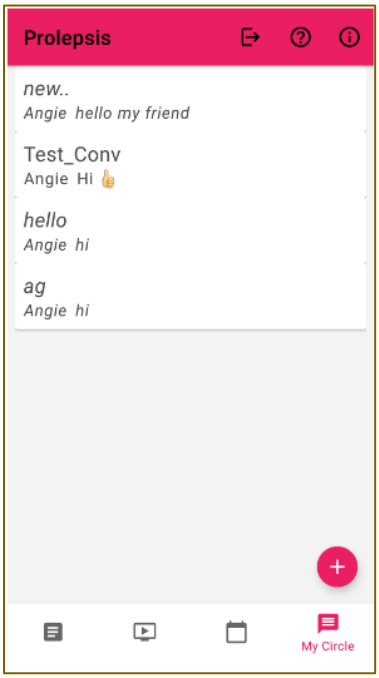




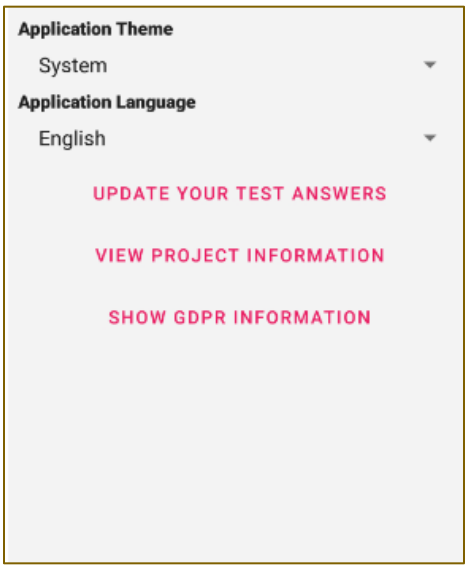
- **History.** The History includes the entry of the monthly menstruation dates, as well as the list of the appointments for breast screening that have been completed or to be realized and to insert new dates of appointments. The breastself-examination is considered one of the exams, along with MRI, Mammography, Ultrasound. A star rating is filled with color when a self-examination is completed. Reminder notification is send the previous day of the appointment date.



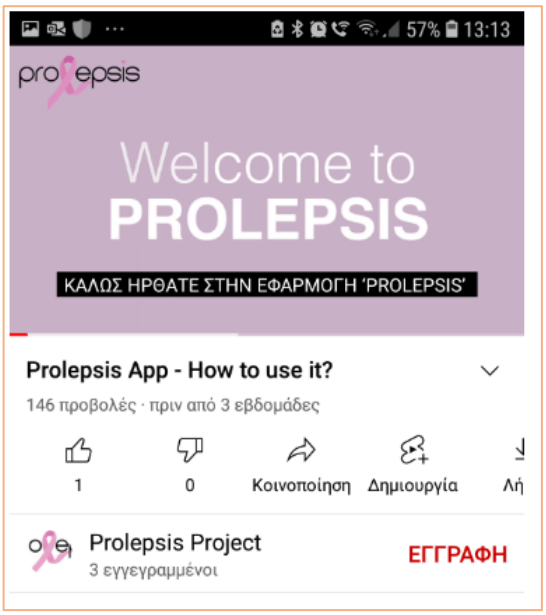
- **Chat.** The application provides a chatting system, among users of the mobile application, that are invited and also asked to join a conversation.



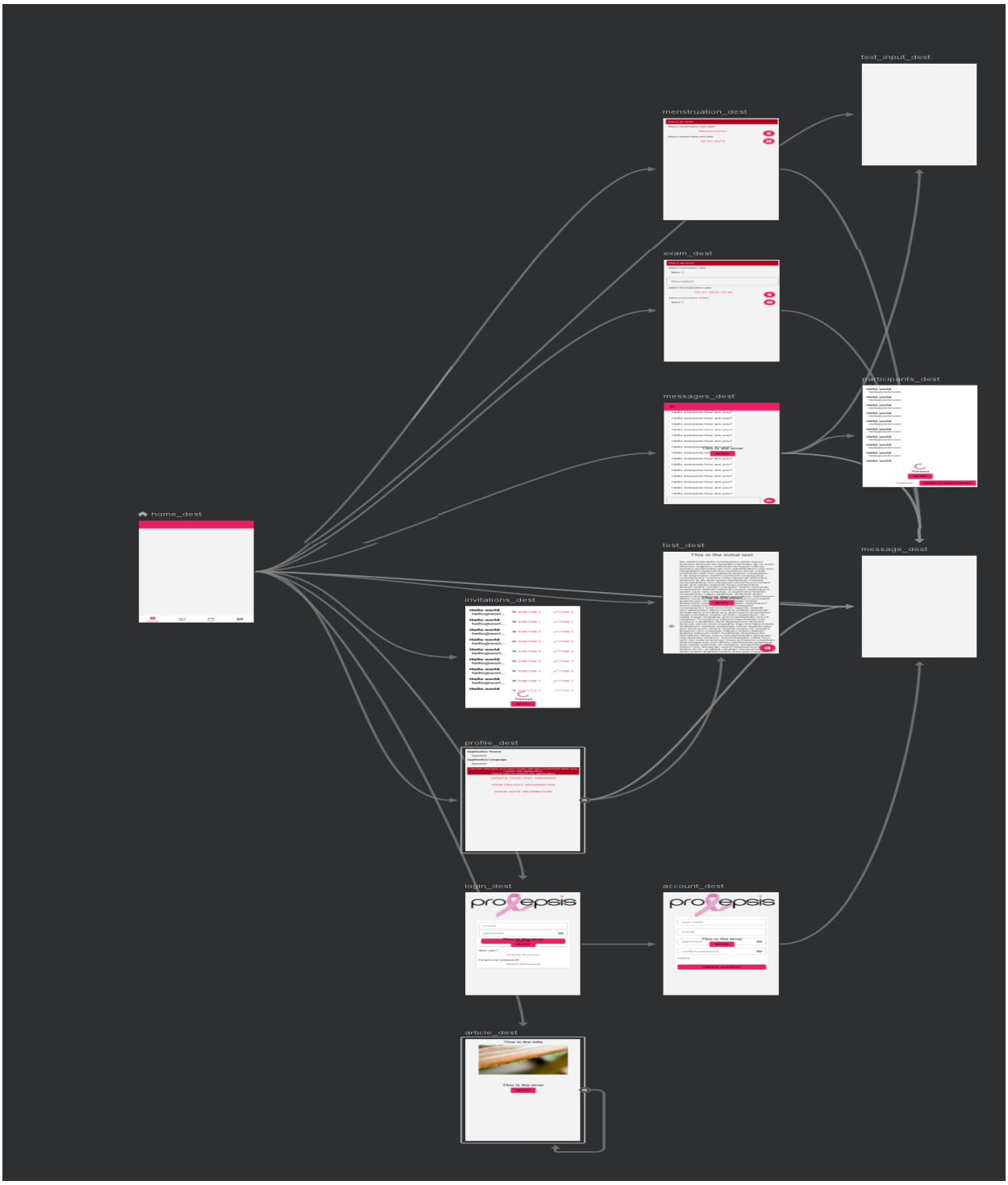
- **Setting and Profile**. The certain icon opens a menu with listed options to use as the color of the background, the preferred language to use the application, to update the initial assessment, show the GDPR information and see the welcome page.



- The help button opens a video of how to use the Prolepsis mobile app and is available within the mobile application.



A diagram of the mobile's application interconnections is presented at the following image:


text_input_dest
menstruation_dest
exam_dest
participants_dest
messages_dest
home_dest
test_dest
message_dest
invitations_dest
profile_dest
login_dest
account_dest
article_dest

1.4 TRANSLATION AND CUSTOMIZATION OF CONTENTS

A google sheet was created with all the required translations. A base English translation was added for the different phrases that were used and each partner was required to fill in the corresponding Greek, Italian and Portuguese translations.

For the mobile platforms there were two types of translation needed, one was hardcoded inside the application and would be immutable, the other was provided by the backend server and could be changed by the platform's administrator website. Each article registered in the administrator website would now be translated by that language's representative and for each new article each representative would be responsible for translating it in their language.

The requests made by each mobile platform would now incorporate locales other than English, and the server would respond in the appropriate language. Since some content was delivered to the users without them making a request (notifications about upcoming exams, motivational messages etc) as an added step when the user changed the application's language, a new request was made to the server, to tie in the specific user (if they had an account) with a language.

Chapter 2 : The Platform's Backend

2.1 DESIGN & DEVELOPMENTOF THE BACKEND

Backend is the system that all the information are gathered and stored in a database, as well as where all the algorithms are implemented. The design of the backend system was realised with RESTful API protocol to save and show information provided by the end users and from the web interface (dashboard) for admin users and region admins.

For the implementation, Laravel was used, one of the best php frameworks, that provides security of data, stability and excellent community support. Laravel is used by the biggest companies in the world, to make web services and web applications. An API for a website is code that allows two software programs to communicate with each other. The API spells out the proper way for a developer to write a program requesting services from an operating system or other application. A RESTful API -- also referred to as a RESTful web service or REST API -- is based on representational state transfer (REST), which is an architectural style and approach to communications often used in web services development.

A sophisticated Laravel based on restful web service application should comprise of some key component, such as routing engine, middleware, MVC framework, ORM and authentication component. When a client sends a request to Laravel restful API through HTTP, the web server first receives the request and passing through to PHP Engine, then the actual execution starts from Laravel initialize routines. When the Laravel initialize routines finish some configuration, the request is then passed to middleware engine for filtering. After filtering comes the core routing component responsible for request dispatching, according to the route configuration table. Finally, the MVC controller takes over the dispatched request. In general, the controller is responsible for application logic execution and inquire the model for data fetch and persistent. The view component takes over the last piece of work for rendering the page. However, when Restful API is build, page rendering is useless, so only controller and model are involved and at the end of the process only Data encoded with JSON will be returned. Laravel provides a powerful ORM framework for relational database manipulate and the model depends heavily on ORM for data processing.

Indicative examples of the backend operations are: the user risk after the initial test, automatically email sending in region admins to translate article, messages and videos, statistics show in the dashboard, notifications to end users and so on.

2.2 TRANSLATION AND CUSTOMIZATION OF CONTENTS

All the translations of the web platform and the customization of content was done by the backend through two different systems, one for translating labels in the dashboard and one for translating database saved information, as the initial test of user.
The database translation manager can be accessed from the super admin user and from region admins. The label translation manager can be accessed only from the region admins. Region admins are also the ones who can customize the content of the articles videos and messages that are shown through mobile devices to the end user.
Every time an article or video is created and inserted at the platform, an email is sent to other region admins to make the appropriate changes in the content or to translate the initial content.

2.3 NOTIFICATION AND REMINDER

The backend is also responsible for sending reminder notifications the previous day if the end user has scheduled an exam in a specific date or to send random personalised messages, from the front-end platform, preventing bad habits or to encourage users to act or consulting them in nutrition.
When an article or video is published, a notification will be send to the end users so as to see the new content, read the article or watch the video.
The following figure shows the connection of the back end and the front end:

Chapter 3 : The Platform's Frontend

3.1 DESIGN OF THE WEB INTERFACE

The web administration platform was implemented using the popular React.js JavaScript framework. It was selected as it is one of the three (together with Angular and Vue.js) industry standard solutions for building modern and responsive web applications. It is developed, used and maintained by Facebook with an active community behind it. The world's biggest websites and applications use React.js as their frontend solution.

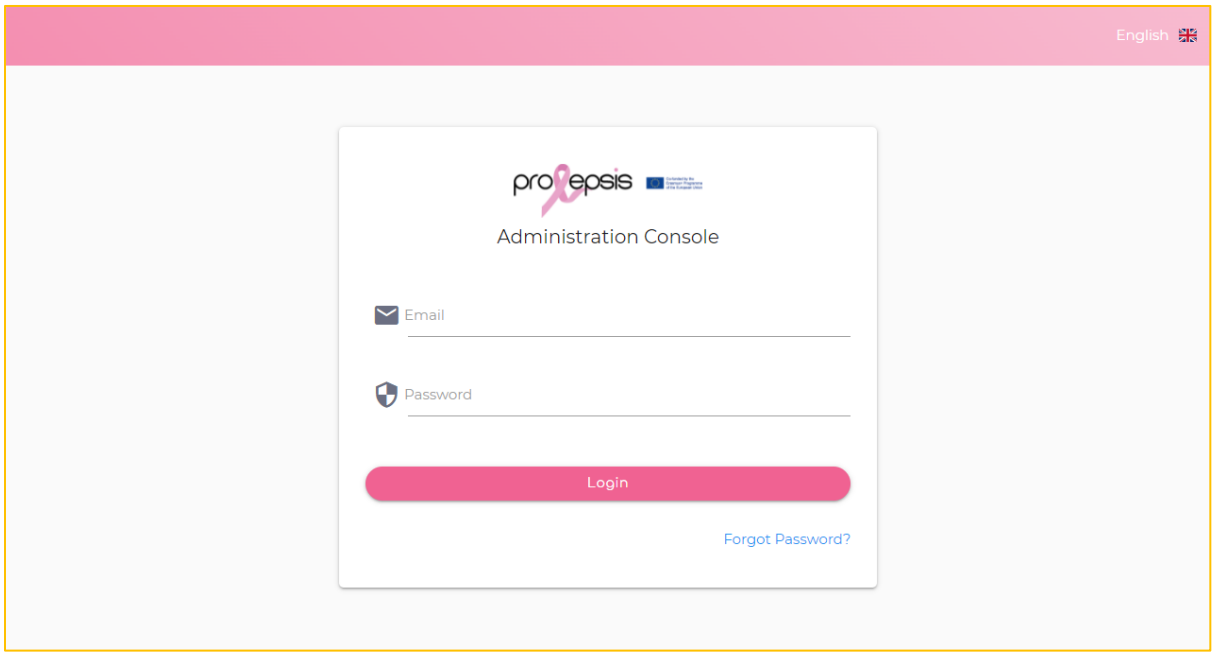
The interface is a single page application meaning that the navigation between pages of the platform does not require the website to be reloaded, resulting in a faster and more pleasant user experience than traditional websites.

Additional packages were used along with React.js to support the project's needs such as Redux, Chart.js, Axios, React-table, React Router. All were carefully selected to be secure and actively maintained. Finally, the interface's design was implemented using the powerful Materialize-css framework which focuses on the user experience.

As mentioned in the previous section the web application communicates with the backend system using the RESTful API protocol and maintains the applications state using the Redux library. The interface's main responsibility is the content management by the administrators that are seen by the user's in the mobile applications. The interface also provides translation systems for the content.

3.2 SECTIONS OF THE WEB INTERFACE

The whole interface is securely accessed using the correct credentials. No unauthorized or public access is possible to ensure the project's data privacy.



After a successful login to the interface, the administrator can access a series of pages using the left side navigation area.

The top bar provides a quick way for the admin to change the interface's language and menu items to edit his/her profile and password.

The interface provides a complete set of options to create, view, search, edit and delete each of the three content types.

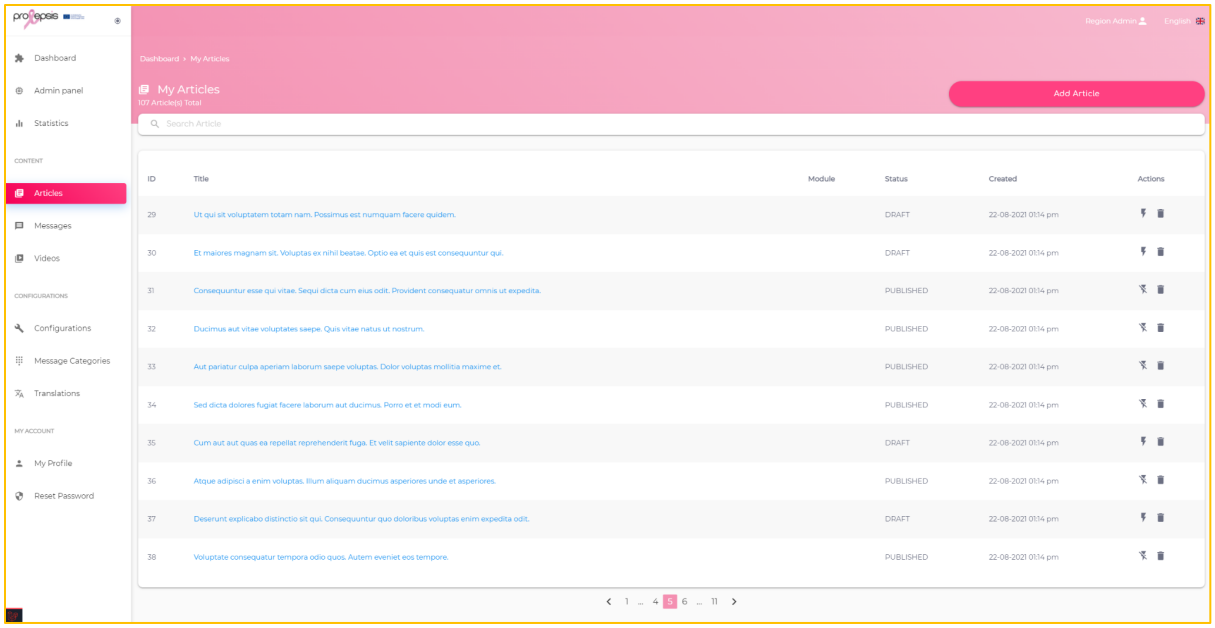
Quick actions were also added where necessary to improve the user's experience.

The management of the content (Articles, Messages and Videos) that is seen on the mobile applications can be accessed from the sidebar.

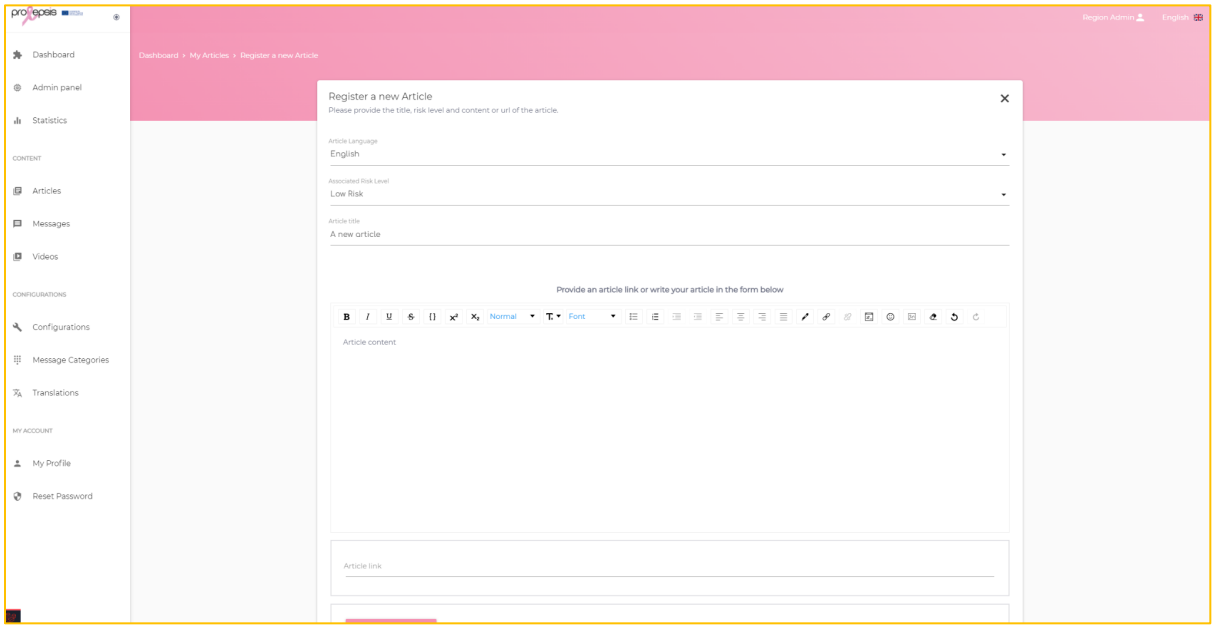
It also provides additional configuration parameters for those content types and links for the two different translation systems explained in the previous section.

Finally, the interface provides a statistics page for the risk levels of the users.

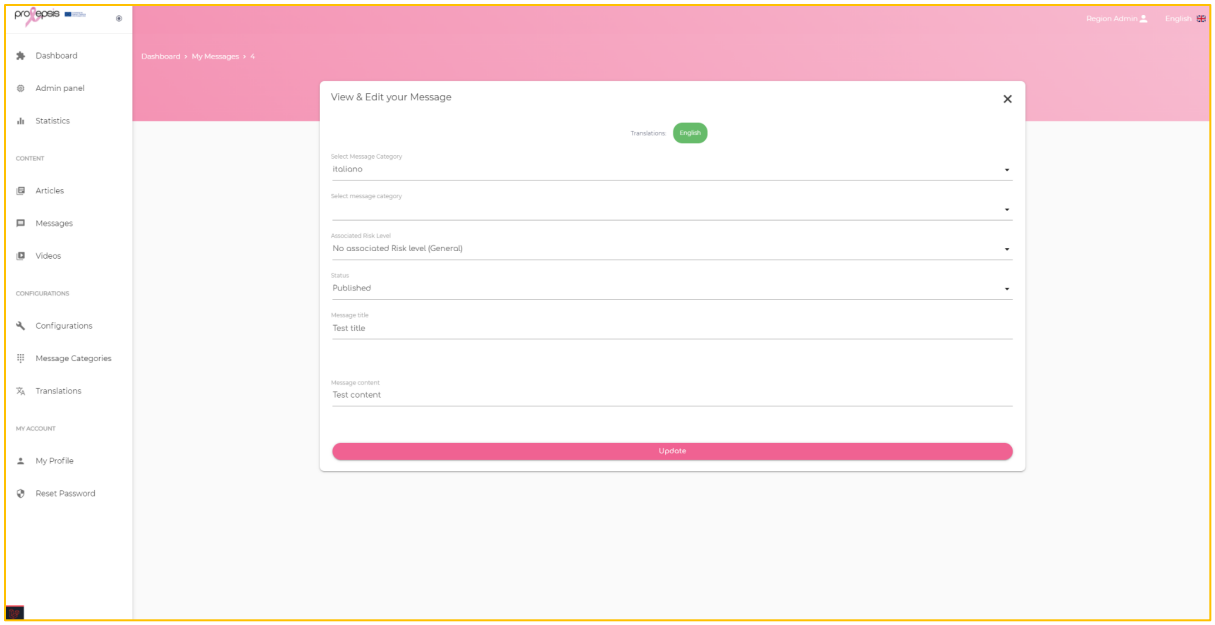
Interacting with the content follows the same interface elements for all content types making the learning curve for using the platform short.



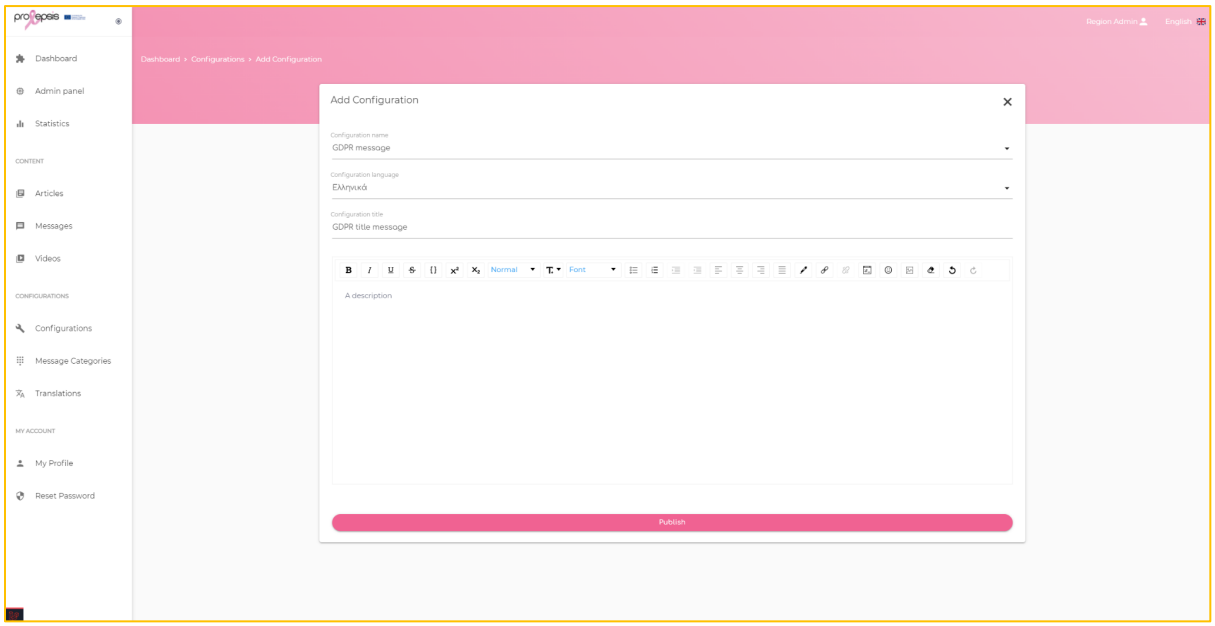
Articles table



New article creation



New message creation



Configuration creation

GDPR – privacy & security

The Prolepsis Solutions ensures security and & privacy based on the following:

- It is Align with GDPR

- Personal identification information: only e-mails address, secured due to the following integrated parameters.
  - None of the user roles has access, in any way, to end users' data.
  - All connections encrypted via SSL.
  - Number of services accessing the users' e-mail, have been minimized.
  - Database backups stored in encrypted form.
  - Security rules followed to ensure integrity & prevent exposure of users' data.

- Other identification information:
  - Chats
  - Country
  - Exams
  - From the initial test: only the score and the risk category
  - Menstruation
  - Articles & video viewed

- User provide most of collected data. Collect, store and process data when user signs up
- Receives data indirectly from the following sources:
  participation in chats
  - watch videos and read articles
  - Data used for personalize user's account & maximise user experience
  - Data securely stored in project's database (azure). Pilots not exceed 2months
  - Delete data by deleting users account
  - Use of cookies will not be implemented

PROLEPSIS keeps its privacy policy under regular review and ensures implementation of GDPR.

Conclusion

The PROLEPSIS application is user friendly, simple to use, intuitively learned and easy to be guided, helpful with the content that has a holistic approach to the breast cancer prevention and early detection.

Its concept is based to the convenience that a mobile application provides. As the informal carers have lack of free time, it takes advantage of some minutes that the informal carer will have and will be able to read or watch a video related to the certain issue, from many aspects, keep track of the history, be reminded of the appointments, have a glance at the messages, participate in small chats regarding the certain matter and more significant that everything is realized directly without a time cost.

From the first inspiration to the development of the PROLEPSIS Application, the journey was very educational, creative and under a great team work. Moreover, the feedback from the pilots, in order to emphasize where the end users indicated the important issues, was very useful and helpful to correct and fine-tune the application.

The Prolepsis Application has potential to expand its use in other target groups, as well as to other thematic, in future projects. It has the ability to provide further functionalities and more complicated operations, without becoming complicated to use, however increase its positive impact in the lives of the interested users, especially when it concerns such a sensitive and significant issue.

ANEEXES

Appendix I The PROLEPSIS APP video “How to use it” https://www.youtube.com/watch?v=-Azc8hRIA6Q

Appendix II The manuals of the Prolepsis Administrative Platform and the Mobile Application will be uploaded at the Prolepsis website https://prolepsis.eu/