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Registration and Monitoring of Civil Protection Emergency Levels

DEISI11

Final Course Work

Final report

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Abstract

The State of Special Readiness (*Estado de Prontidão Especial*, EPE) is a system managed by the Portuguese National Authority for Emergency and Civil Protection (*Autoridade Nacional de Emergência e Proteção Civil*, ANEPC) that aims at fortifying preparatory actions for emergency interventions and diminishing their repercussions. This system is integral in strategically deploying human and material resources, establishing a state of readiness to address various incidents, such as fires and floods, effectively. The management of information pertinent to this readiness state can be further optimized. Here, I report on the development of a new web application aimed at empowering users to oversee and administer emergency levels, incident reports, and resources. This is crucial in ensuring streamlined communication and management during emergencies, potentially mitigating damage, and preserving human lives. This application will be developed using Spring Boot (Java) and Thymeleaf, featuring connectivity to a MySQL database. Further, the application will streamline administrative tasks and improve communication among trusted users, thereby providing a significant step forward in the management of emergency situations.

Resumo

O Estado de Prontidão Especial (EPE) é um sistema gerido pela Autoridade Nacional de Emergência e Proteção Civil (ANEPC) que visa fortalecer as ações preparatórias para intervenções de emergência e diminuir as repercussões destas últimas. Este sistema é fundamental para a afetação estratégica de recursos humanos e materiais, estabelecendo um estado de prontidão imediata para enfrentar eficazmente diversos incidentes, como incêndios e inundações. A gestão da informação pertinente para este estado de prontidão pode ser otimizada. Aqui, apresenta-se o desenvolvimento de uma nova aplicação web destinada a capacitar os utilizadores para supervisionar e administrar os níveis de emergência, relatórios de incidentes e recursos, assegurando uma comunicação e gestão simplificadas durante emergências, mitigando danos e preservando vidas humanas. Esta aplicação será desenvolvida utilizando Spring Boot (Java) e Thymeleaf, com conectividade a uma base de dados MySQL. Esta aplicação irá simplificar as tarefas administrativas e melhorar a comunicação entre os utilizadores de confiança, proporcionando assim um avanço significativo na gestão de situações de emergência.

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1 Identifying the problem

In the realm of emergency management, the efficiency and reliability of processes play pivotal roles in ensuring timely responses and effective decision-making. For ANEPC, the current procedures are centered in the creation of Technical-Operational Announcements (*Comunicado Técnico-Operacional Nacional*, CTO). As these documents require manual interventions and lack streamlined data management, they represent a major bottleneck. This narrative aims to shed light on the current challenges and introduces a transformative solution through a new web application.

Presently, the creation of CTO's is a labor-intensive process that consumes a significant amount of time and human resources. ANEPC gathers information from various sources, including Portuguese Institute for the Ocean and Atmosphere (*Instituto Português do Mar e da Atmosfera*, IPMA). Subsequently, ANEPC analyzes the received data, manually writes fitting content, and assesses the level of risk for each city council. Once this information has been processed and documented, ANEPC manually adds the corresponding risk level colors to the map of Portugal, by manually matching and applying the appropriate color to each region on the map. Upon completion of the CTO, it must be sent to another individual for a manual review. Upon approval, the CTO is archived in a SharePoint repository. One major hurdle faced is the difficulty in data collection. Without a centralized or digitized system, gathering data becomes a challenge, leading to possible discrepancies or missing information. Furthermore, the absence of a dedicated statistical tool complicates the process of evaluating and analyzing the data. This makes it challenging to discern patterns or trends that could inform on decision-making.

Sharing information internally within ANEPC, as well as externally with collaborating organizations, or the public, is another point. Without a robust digital platform, document approvals become a lengthy process, often causing delays in disseminating vital information. This manual process not only affects the efficiency of operations but also has a demoralizing effect on the staff who are burdened with repetitive and manual tasks.

Moreover, there is no designated database to store the created CTOs, which exacerbates inefficiency and hinders effective retrieval and management of critical data. The current system lacks the capability to query specific statistics related to past events and consolidates all saved information within a repository that restricts the accessibility and utilization of relevant data.

Security is another pressing concern. The manual nature of the current procedures poses potential risks in terms of data integrity and confidentiality. A centralized, digital solution would not only streamline processes but also provide enhanced security features to safeguard critical data.

Often, ANEPC makes a map of the country during the CTO creation, illustrating the varying levels of EPE by hand. While the integration of the two tasks is valuable, it relies on a process that is markedly laborious and inefficient. Below, Figure 1 presents an example:

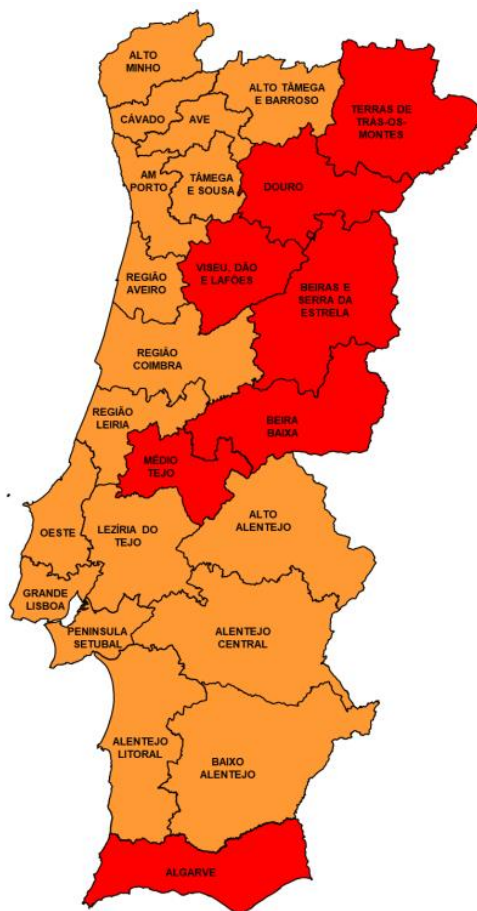


Figure 1 - Map of Special Alert State (*Mapa de Estado de Alerta Especial*)

Map of Portugal, with Districts identified. Depicted is one example in which districts were colored according to emergency levels reflecting their risk of fire. Red reflects a higher risk than orange.

Source: [Comunicado 46 de 24AGO23 Perigo Incêndio Rural Agravamento do EAE Laranja Vermelho.pdf](#)

In sum, the challenges faced by ANEPC in managing CTOs are indicative of a broader need for modern digital solutions in emergency management. The proposed web application is more than just a tool. Indeed, it is a strategic step forward, towards harnessing the power of technology to overcome manual inefficiencies. As ANEPC embarks on this journey of digital transformation, it is set to redefine its operational landscape, aligning more closely with the demands of contemporary emergency - management and the expectations of the communities it serves.

With the aim of developing a web application that is effective in advancing the current capabilities of ANEPC in emergency management and activation of the downstream measures, we sought to integrate the following objectives:

- Generate a CTO automatically
- Save all information into a Database
- Let users review the submission of a CTO
- Generate Statistics into a .csv file based on all CTOs

The final product successfully met all objectives. The exception was the notification of users that must review a CTO. This was to avoid complicating the process, as the user would have to be defined a priori. Such an option would create a bottleneck that is not helpful in emergency settings, so we opted by not implementing this feature.

2 Feasibility and Relevance

ANEPC has reached a critical juncture in its operational journey. The intersection where technological advancements transition from mere enhancements to absolute necessities is now evident. The escalating complexities and demands of emergency management require solutions that are not only effective but also swift, reliable, and far-reaching. The proposed web application rises to this occasion, embodying both feasibility and profound relevance.

2.1 A Catalyst for Transformation

ANEPC's present challenges, characterized by the labor-intensive nature of tasks from CTO creation to document storage and sharing, significantly inhibit its agility in emergency response. The proposed application tackles these challenges, promoting a transformative shift. By introducing digitization and automation to these foundational processes, ANEPC can look forward to pronounced enhancements in emergency response times. The invaluable time salvaged from obviating manual interventions can be channeled towards mission-critical activities. This includes sharpened decision-making and immediate lifesaving actions, culminating in more effective and efficient outcomes.

2.2 Enhancing Collaboration and Communication

The application materializes as a robust conduit for unhindered communication and efficient data dissemination among a number of collaborators, that encompass firefighters, institutions like IPMA, City Halls, "freguesias", the National Republican Guard (*Guarda Nacional Republicana*, GNR), among others. Given Portugal's vast geographical scope and the diverse array of emergencies it implies, a centralized, digital way of optimizing the response to emergency is a priority. This application will enable that indispensable information swiftly reaches its intended recipients, effectively sidelining delays, misinterpretations and potential operational vacuums.

2.3 Future-Proofing through Technology

The forward-thinking blueprint of the proposed application is among its standout attributes. While its immediate transformative potential is palpable, its evolutionary trajectory promises enduring relevance. A pivotal element in this roadmap is the possibility for future integration of artificial intelligence capabilities, geared to interpret data from many external entities. This augurs a future where the system autonomously assimilates incoming data, discerns emergent patterns, and dispenses real-time, actionable insights.

There was an original decision to use React bootstrap to underpin the web application, as it has several forward-looking advantages: Reacts inherent flexibility and adaptability would bolster the web platform, opening the possibility to develop a mobile application. As previously highlighted, React

offers unparalleled advantages in the realm of mobile cross-platform frameworks, ensuring that ANEPC will be able to choose to expand to mobile platforms, to enhance accessibility and responsiveness on-the-go. However, we found that React bootstrap ended up overcomplicating the development process and opted to exclusively use Spring boot. This did not compromise any of the features we originally planned to integrate in the application. Indeed, the application creates CTO's and statistics based on a form, with all the information being saved in a database.

ANEPC has ran several tests spanning from CTO creation, approval, denial and .csv file generation by simulating emergency situations. Overall, ANEPC's feedback supports that CTO creation and review, as well as the creation of statistics based on these CTO's became a simple process. These tests showed that this web application will become a central tool for the ANEPC capacity to manage information and mobilize actions, which will have a major impact on emergency management. This web application, though primarily a tool, signifies a noteworthy advance in reshaping emergency management in Portugal.

3 Benchmarking

In today's digital era, efficient and streamlined systems are imperative for organizations to stay competitive and responsive. For ANEPC, the challenges surrounding the management of CTOs have highlighted a pressing need for modernization. Here, the current challenges will be explored, potential platforms evaluated, and a strategic solution tailored to ANEPC's evolving needs will be proposed.

At present, there is no substantial infrastructure in place to streamline the generation of the aforementioned CTOs, that rely on labor-intensive manual processes. While there has been a recent attempt to amend this through the introduction of a rudimentary website to transmit statistics, its use is limited. Adding onto that, it fails to incorporate the remainder of the features previously outlined, that are essential for an increase in efficiency for the creation of CTO's. As articulated in Section 1, "Identifying the Problem," the existing system is obsolete and is in dire need of upgrades to boost operational efficacy. When considering suitable platforms for ANEPC's requirements, content management systems (CMS) like SharePoint and Liferay emerge as potential solutions. These CMSs cater to several of ANEPC's current needs, including the creation of forms for the CTOs and their subsequent approvals. Moreover, they provide features like login restrictions to access specific documents, and the ability to store documents in databases in JSON format.

However, these CMS platforms come with their own set of challenges. The foremost is the steep learning curve associated with their use. Additionally, they don't encompass all requirements that ANEPC envisions. This includes the need to generate a pdf file based on a form, among other aspects that will be discussed in the corresponding sections. Furthermore, the potential of these CMS platforms for future expandability is limited. Finally, in a live or production environment, they require payment. In this scenario, it made no sense to compare current alternatives. Indeed, the results of our tests indicate that our solution surpassed the current competition.

To address these challenges and offer a more holistic solution, the proposed website development in this "Final Course Work" (*Trabalho Final de Curso*, TFC) aims to go beyond the development of the capabilities of the mentioned CMSs. This new platform will enable showcasing detailed graphics and data based on user-specified inputs from the CTOs. Its design philosophy prioritizes user-friendliness, ensuring that even those with no prior experience can navigate the application.

The foundation for this responsive interface was planned to be React, a renowned JavaScript library. While competitors such as Angular and Vue were considered, React stood out for several reasons. Its expansive and vibrant ecosystem offers a plethora of third-party libraries, tools, and robust community support [LOGR23]. Performance-wise, React outpaces Angular, ensuring faster website responses [RAD123]. The learning curve for React is comparatively gentler, promoting accelerated website development (Same as Last Link). Notably, React also presents superior mobile cross-platform framework solutions compared to Angular, making it a strategic choice for potential future expansion [IMCL23]. Nevertheless, we ended up deciding against React because it unnecessarily complexified the development process. This choice did not impact on the performance of the web application in any way, as Spring boot and Thymeleaf are extremely powerful. This choice was also supported by the lack of a need for a mobile platform in the future, thus making the advantages React would offer, over Spring boot with Thymeleaf, less relevant to this project than anticipated.

In summary, the current challenges faced by ANEPC in managing CTOs, exacerbated by outdated manual processes and insufficient digital tools, underline the need for a robust, user-friendly, and expandable solution. We offer this, as well as a scalable platform for future advancements. As the landscape of content management evolves, ANEPC is well-positioned to stay ahead, ensuring streamlined operations, efficient data handling, and an enhanced user experience for years to come.

3.1 Other countries

To get a comprehensive understanding of CTOs, it is very important that we explore how different countries manage such situations. This analysis compares the entities in charge of emergency management in Germany, the United Kingdom (UK), and the United States (US).

1. Germany - Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK):

Despite identifying the *Bundesamt für Bevölkerungsschutz und Katastrophenhilfe* (BBK) as Germany's counterpart to ANEPC, a specific document outlining CTOs could not be located. The BBK's website [BBK24] offers guidance on individual actions during emergencies but lacks explicit information on the documentation process for CTO events.

2. United Kingdom - Cabinet Office:

In the UK, the Cabinet Office [GOVUK24] seems to be the entity managing emergency matters. While the document equivalent to a CTO is believed to be titled "Emergency Preparedness," [UK24PREP] the exact document could not be located within available sources.

3. United States - Federal Emergency Management Agency (FEMA):

FEMA [FEMA24] in the US is responsible for emergency management, and the "Preliminary Damage Assessment Report" [PDAR24] is identified as a potential counterpart to a CTO. However, details regarding the specific process of creating this document remain unobtainable, assuming that such information is publicly disclosed.

This comparative exploration aims to show the varied approaches these nations take in managing and documenting emergency situations, offering insights into potential best practices and areas for improvement in the creation of CTOs.

4 Engineering

4.1 Requirements gathering and analysis

To successfully meet the requirements set by ANEPC for the web application development, a systematic approach is essential, beginning with the establishment of clear and comprehensive specifications. These specifications, categorized into Functional and Non-functional Requirements, have been defined collaboratively in a meeting with ANEPC.

4.1.1 Functional Requirements

1. Description: Sign into the webapp, with email and password to enable users to use it.

Importance: Must have

Estimated time: 5 days

Acceptance Criteria:

- Let's user access features of the website upon successful login.
- Doesn't let user access webpage if password is wrong.
- Prompts user to input credentials again if they did it wrong.
- Password is encrypted in the Database.
- Depending on the type of profile the user has, they get access to more or less features.
- Users with different roles, are able to access more or less features depending on these roles

2. Description: User can sign out of the webapp.

Importance: Should have

Estimated time: 2 days

Acceptance Criteria:

- The user loses access to all of the features and is prompted to login again.

3. Description: Let users fill in a form to create a CTO and retrieve a pdf file.

Importance: Must have

Estimated time: 12 days

Acceptance Criteria:

- Users have different fields, based on the entities involved and the type of emergency.
- Multiple choice tables exist, and the picked choices can be saved into the Database.
- Various fields can be picked at once, by clicking at the top of the table.
- Only one choice can be made for each line in the multiple-choice lines.

- Users are only able to access the second page of the form, upon filling in every field of the first page.
4. Description: Users can see how the CTO map looks, based on the choices they have made within the Multiple-choice tables.
Importance: Could have
Estimated time: 10 days
Acceptance Criteria:
- A CTO map is generated when the user clicks the view map button.
 - The map has the corresponding colors based on the choices made within the Multiple-choice tables.
5. Description: When the user is on the second page of the CTO creation form, he is allowed to go back to the first page of the form.
Importance: Could have
Estimated time: 4 days
Acceptance Criteria:
- Upon clicking the previous page button, the user is taken back to the previous page of the form.
 - The information the user had filled in on the first page is displayed.
 - When the user goes back to the second page of the form, the information is displayed, even if the user changes something on the first page.
6. Description: Let Users preview how the CTO would look like if they were to finish it at that moment.
Importance: Should have
Estimated time: 5 days
Acceptance Criteria:
- The information filled in by the user is not deleted upon pressing the button.
 - The user downloads the CTO that is generated based on the information that they filled in.
 - The information does not get stored in the database.
 - The CTO correctly generates everything, based on the information that is provided by the user in the form.

7. Description: Being able to send the CTO to be reviewed by another user.

Importance: Could have (Used to be must have)

Estimated time: 15 days

Acceptance Criteria:

- The user can choose who he is sending the CTO to, so it can be reviewed.
- The choices of people have the corresponding profile, to be able to review the CTO.
- The information of the CTO gets stored in the Database, with the “awaiting review” status.
- The information stored in the database is accurate and complete.
- The creator of the CTO, can only send the CTO to be reviewed, upon filling in every field.

8. Description: The reviewer of a CTO is notified by email.

Importance: Could have (Used to be should have)

Estimated time: 3 days

Acceptance Criteria:

- The reviewer of a CTO gets notified per email, that he has to review a CTO.

9. Description: CTOs are displayed in the CTO's list

Importance: Must have

Estimated time: 10 days

Acceptance Criteria:

- CTOs are displayed with their respective name, date, status, and entity.
- Only a person that created a CTO and their reviewer, can see CTO's that have the “pending review” status.
- CTOs with the “pending review” status, are displayed with a blue background for the creator and have a red background for the reviewer.
- CTOs on the list are displayed from newest to oldest, from top to bottom.
- Everyone on the webapp can view just the Map of a CTO and Download the CTO.
- A CTO that was denied, is only displayed to the creator of that CTO, and has a red background.
- A CTO creator can edit the CTO upon it being denied.
- A CTO reviewer can approve or deny a CTO.
- CTOs with Red backgrounds are displayed at the top, following that the ones with blue backgrounds are displayed and then the remaining ones.

10. Description: Someone who is reviewing a CTO can either approve a CTO or deny it.

Importance: Must have

Estimated time: 5 days

Acceptance Criteria:

- A person whose CTO was reviewed receives an email that says if it was accepted or denied.
- Accepting or denying a CTO changes its status and display in the list of CTOs.
- If the reviewer accepts the publication of the CTO, nothing else is requested.
- If the reviewer denies the publication of the CTO, they have to write a reason, as to why it was denied.

11. Description: Editing a CTO that was denied.

Importance: Must have

Estimated time: 4 days

Acceptance Criteria:

- The creator of the CTO can edit the denied CTO.
- The information that exists about the CTO is displayed as if the user was still creating that same CTO.
- The creator can display the reason of denial of that CTO.
- The whole process of editing works the same as publishing a CTO.
- The information in the database gets edited upon deciding to send the CTO to be reviewed again.

12. Description: The notification on the website.

Importance: Nice to have

Estimated time: 5 days

Acceptance Criteria:

- Whenever a user should receive an email, they also get notified on the notification tab within the webapp.

13. Description: Statistics are displayed on the webapp.

Importance: Could have

Estimated time: 5

Acceptance Criteria:

- Tables are displayed correctly depending on the data that is stored in the database.
- Tables are updated whenever new CTOs are created/published.

14. Description: Some fields automatically prefill based on past choices

Importance: Must have

Estimated time: 2 days

Acceptance Criteria:

- Based on the choices made in the first page of the form the text fields get prefilled out
- The fields are editable
- The fields are prefilled, based on a template given by ANEPC
- The fields correspond to the corresponding template

15. Description: Users can download a .csv file with every statistic stored within the database.

Importance: Must have

Estimated time: 8 days

Acceptance Criteria:

- When the user presses the download statistics button, a .csv file is generated with every statistic from the database, and it is downloaded by the user.
- The file contains all the data.
- The data is accurate and up to date.

16. Description: AI analyses documents received from other entities such as IPMA and helps fill out the creation of a CTO based on that information.

Importance: Nice to have

Estimated time: Very long, don't have the knowledge to give an accurate estimate

Acceptance Criteria:

- Accurately interprets the text and fills out the fields based on the documents correctly

4.1.2 Non-functional Requirements

1. Information is safely saved within the database.
2. Compatible with multiple users running the webapp at once.
3. Multiplatform compatibility.
4. Access to webapp is available 24/7.
5. Guarantee logging during access and use of operations within the webapp.

Based on feedback received from a meeting with ANEPC, we have adapted the requirements to represent their needs better. Based on their feedback, we have added further features and functionalities, but these are mostly not requirements, which is why they are not represented here. Specifically, ANEPC specified how the tables for the EPE levels in the form should function, the

procedure from creating a CTO until its final submission has to work and, finally, how the CTO and .csv files have to look. The importance of each requirement was determined at the beginning of this project with the contribution of ANEPC. The following requirements were not implemented or changed:

Requirement 5, was not implemented as the back button from the browser already fulfills this requirement, without needing to create a specific button for that same feature. Features 7 and 8, were not implemented and were changed to “could have”, as specifying the user who has to review the CTO would make the process slower, due to only that person being the one who can review the CTO. Adding onto that, the users with the Approver role, can just see all CTOs that can be reviewed on the CTOs list, and due to time constraints we prioritized other requirements that were deemed more important. Requirement 12 was also not implemented, as its importance was qualified as “nice to have”, which is why we prioritized other requirements. Requirement 13 was changed to show statistics in form of tables, instead of graphs as it does the same as the graphs, makes it easier to use and saves time that can be used on other requirements. Finally, the only non-functional requirement that was removed, was logging which we decided against, as the most important information already gets automatically registered in the database.

4.2 Use Case Diagrams

In the upcoming section, I will present four use case diagrams, illustrating various scenarios and interactions within the system.

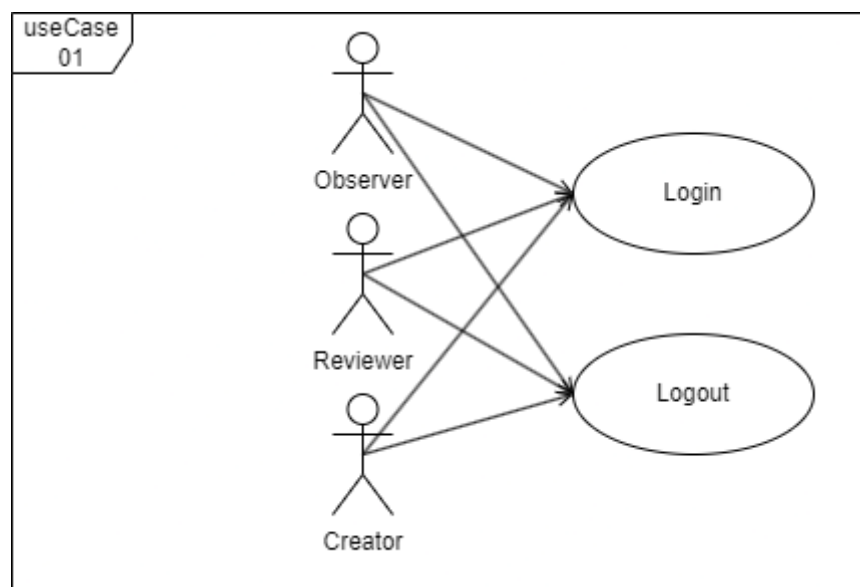


Figure 2 - UC01

This is the Use Case 01, which represents the Login and Logout procedures for the Observer, Reviewer, and Creator.

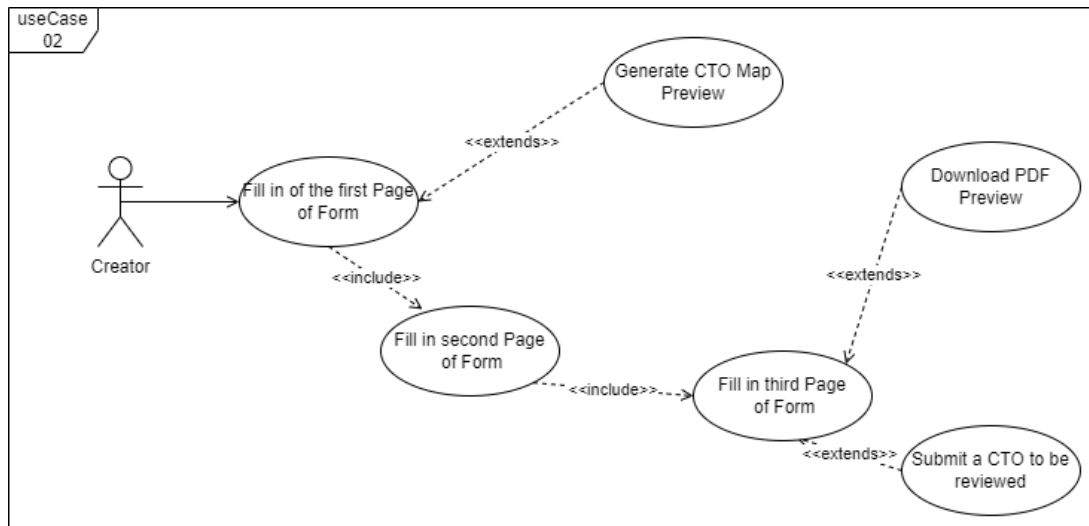


Figure 3 - UC02

This is the Use Case 02, which represents the Process of creating a CTO with the Creator profile.

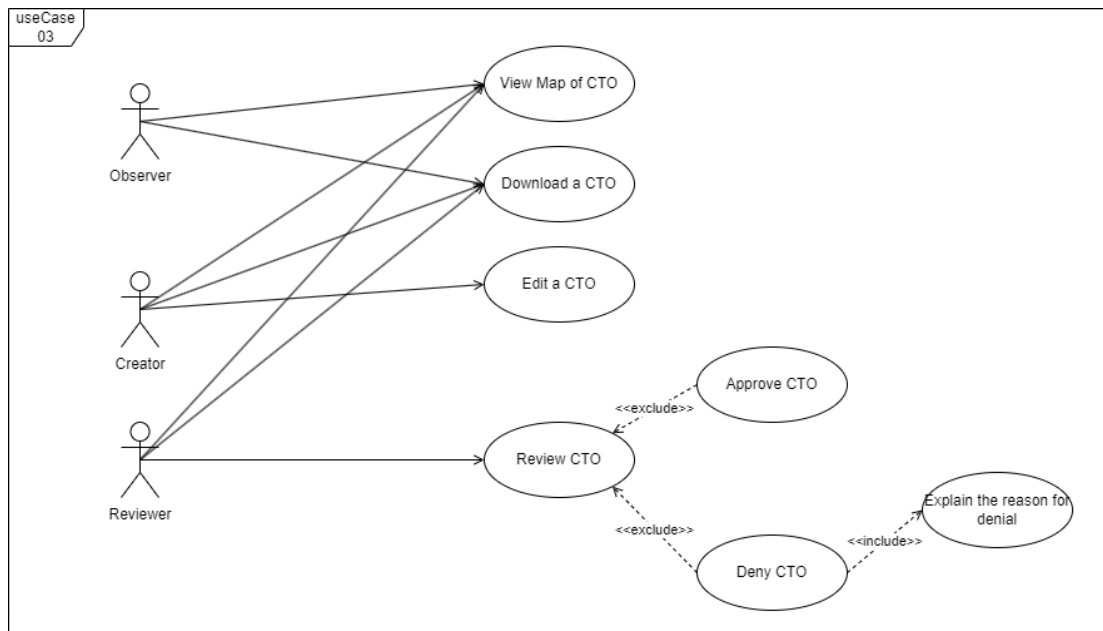


Figure 4 - UC03

The Use Case 03 represents all the actions a user with varying profiles can initiate.

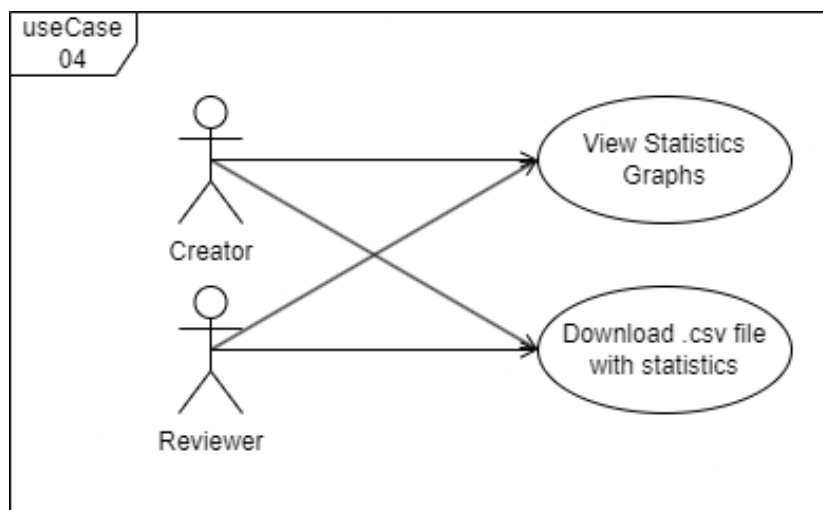


Figure 5 - UC04

This is the Use Case 04, which represents the profiles that can view statistics Graphs and Download the .csv file with statistics.

4.3 Activity diagrams

This Section depicts various Activity diagrams, that are based on the Functional Requirements.

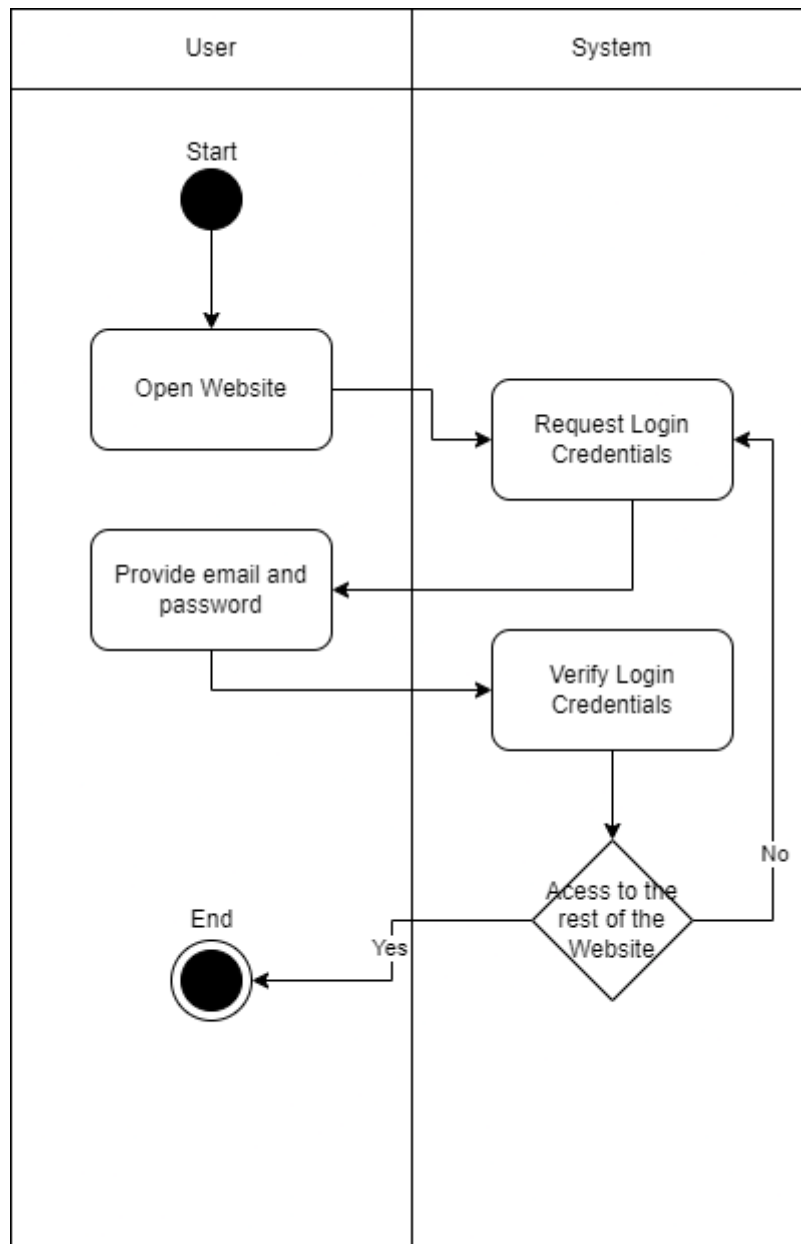


Figure 6 - Activity Diagram 1

This Activity Diagram shows the procedure, to log into the webapp.

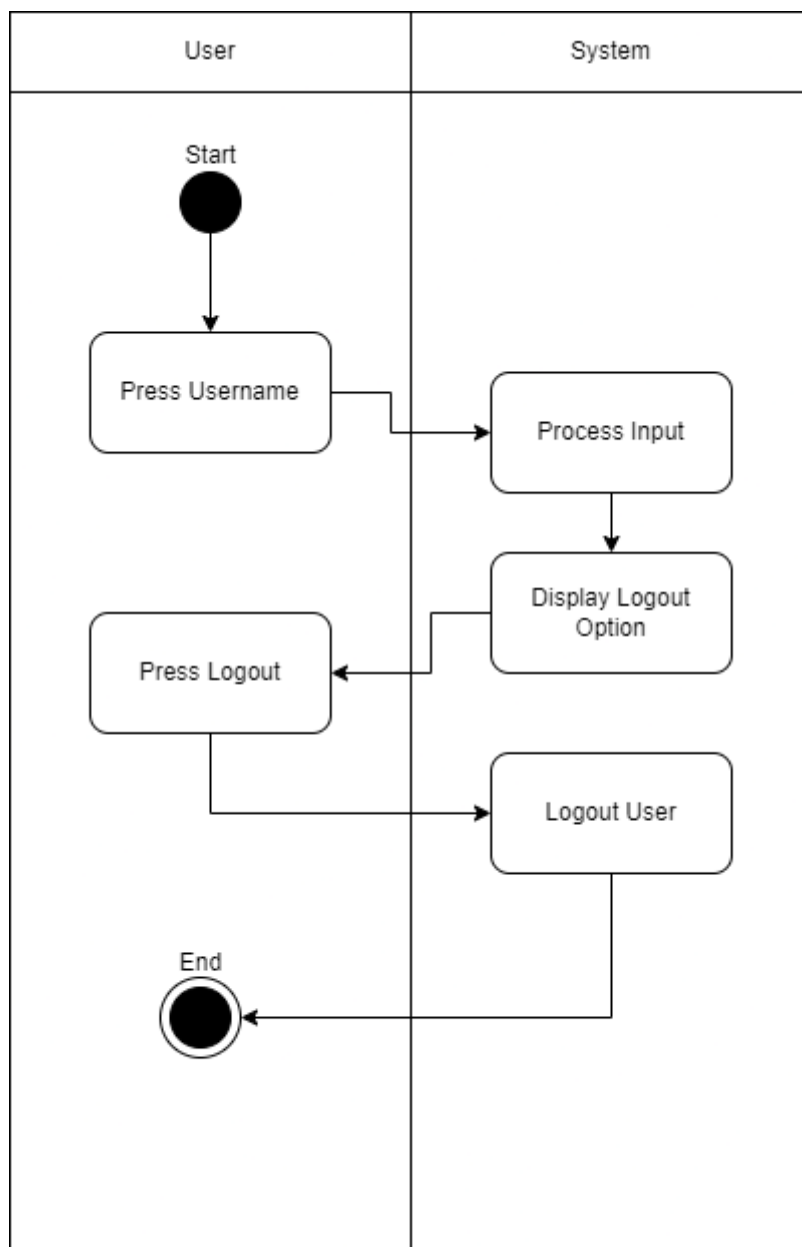


Figure 7 - Activity Diagram 2

This Activity Diagram shows the process for a user to Logout.

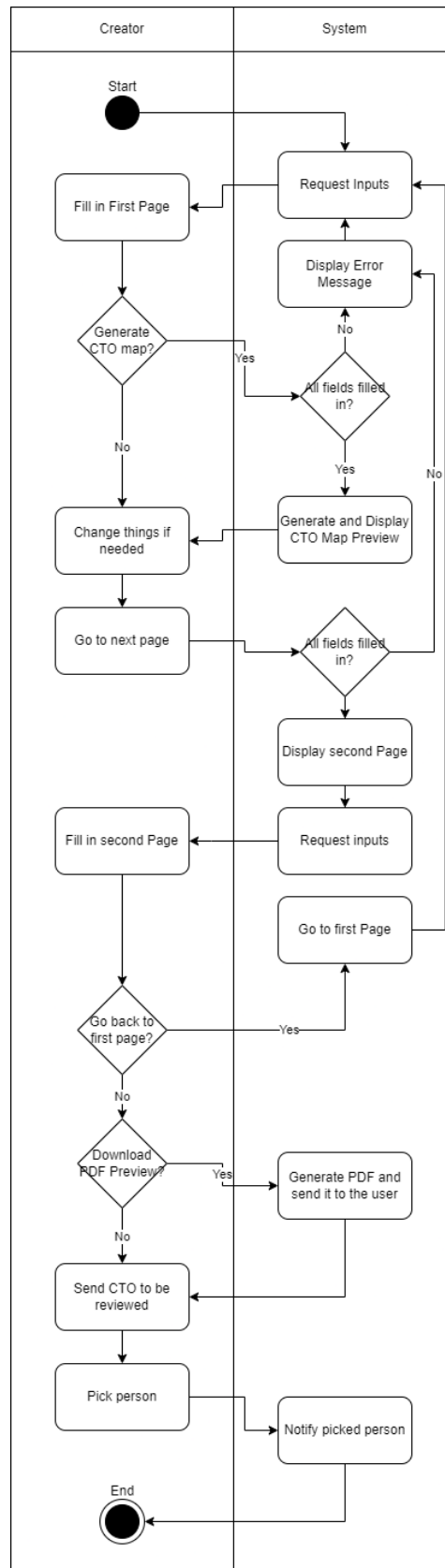
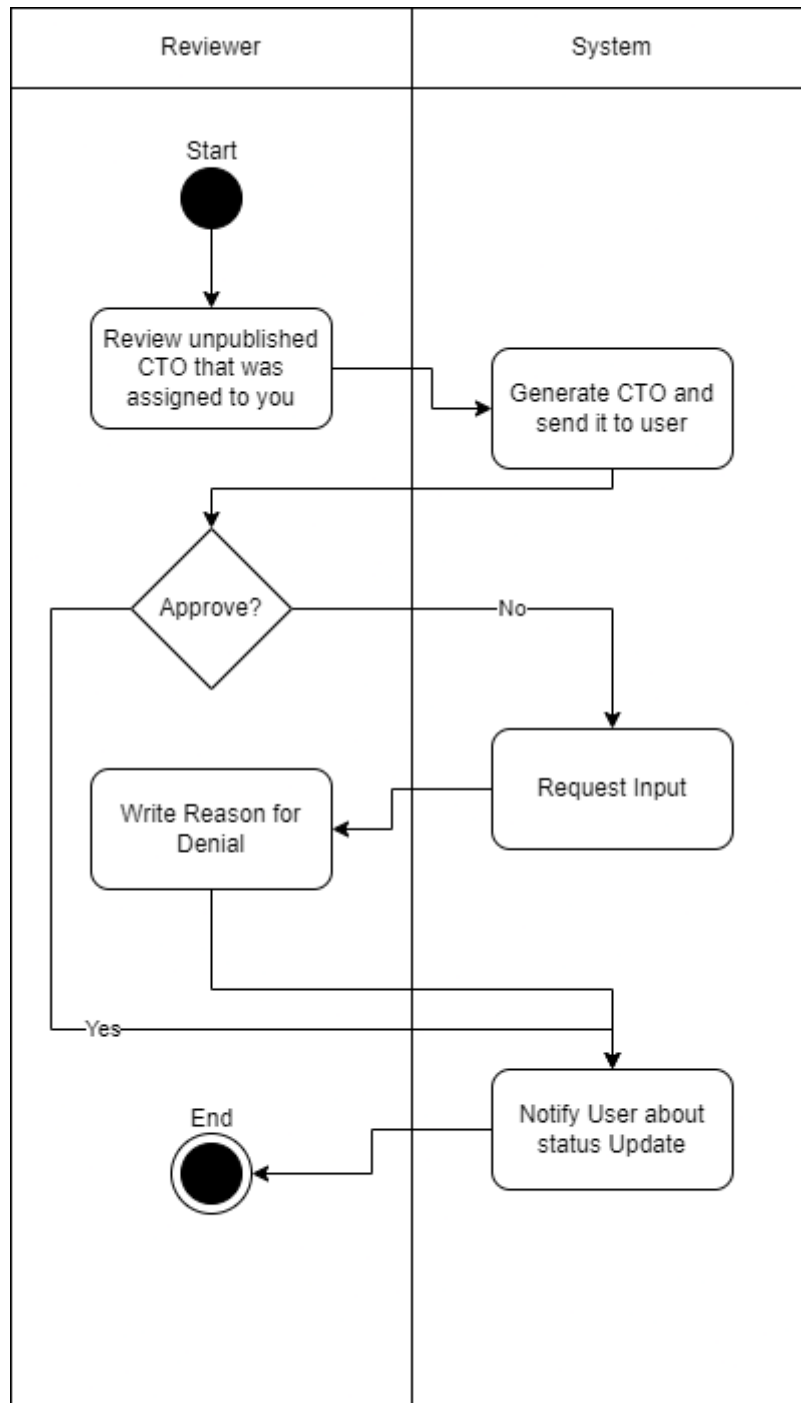
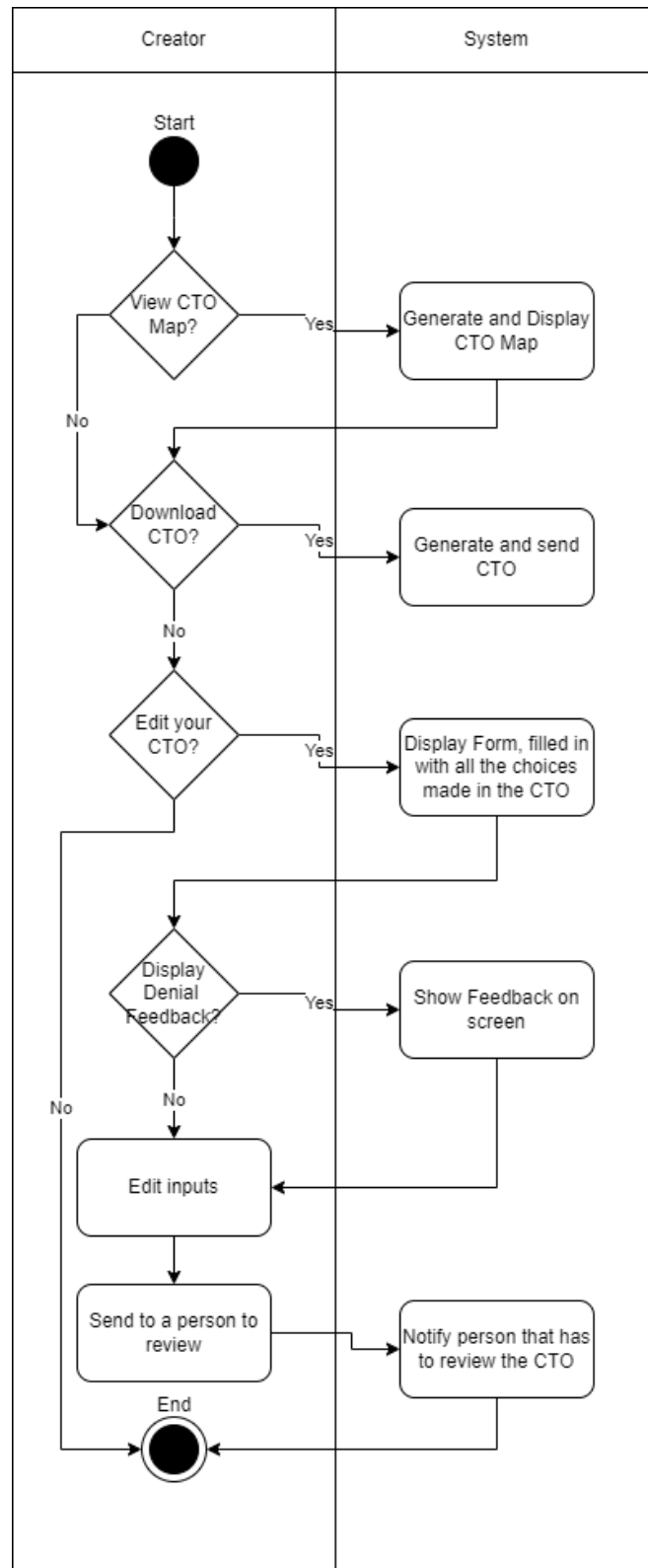


Figure 8 - Activity Diagram 3

This Activity Diagram represents the process of a user with a Creator profile, while creating a CTO.

**Figure 9 - Activity Diagram 4**

This Activity Diagram shows the process between a user with a Reviewer profile and the system, to review a CTO.

**Figure 10 - Activity Diagram 5**

This Activity Diagram displays, the actions a user with the Creator profile can take, on the CTO's page.

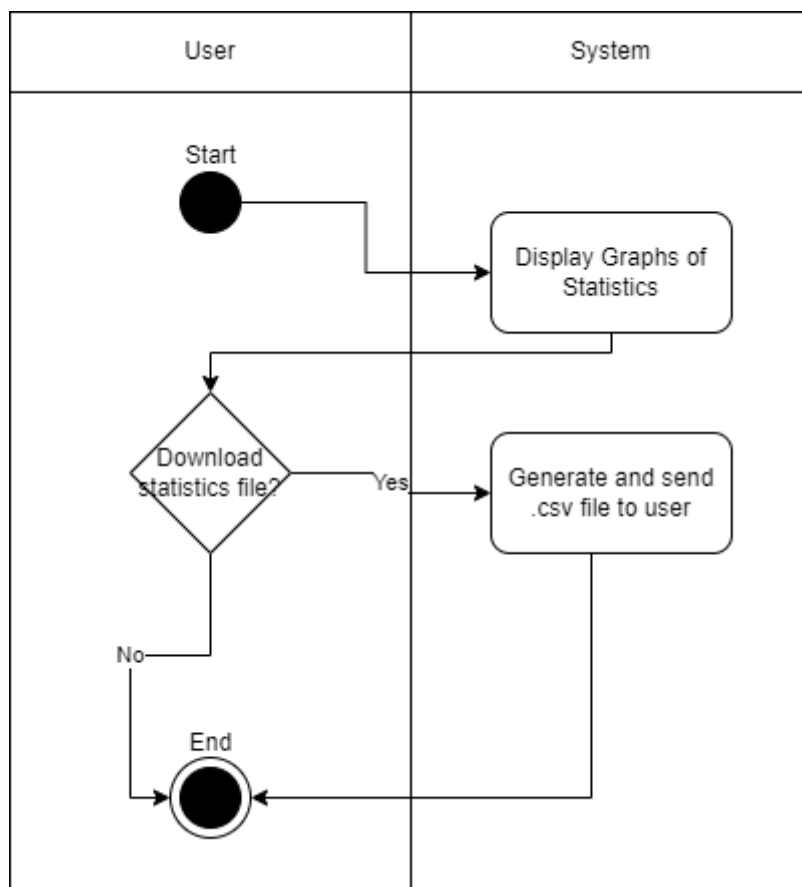


Figure 11 - Activity Diagram 6

This is Activity Diagram shows the activities within the Statistics Page.

4.4 Relevant models

In this section, we focus on two key modelling techniques that play a crucial role in building the project's foundation — the State Diagram, the Entity-Relationship Diagram (ERD) and the Database Model. The State Diagram provides a dynamic depiction of the system's behavioural aspects, offering insights into its various states and transitions. On the other hand, the ERD serves as a structural plan, illustrating the entities and their relationships within the system. Lastly, the Database Model displays the tables of the Database and their respective keys.

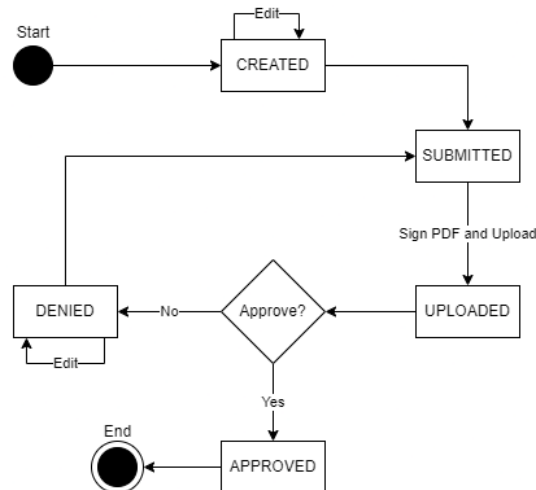


Figure 12 - State Diagram

This State Diagram represents the different states a CTO can be in.

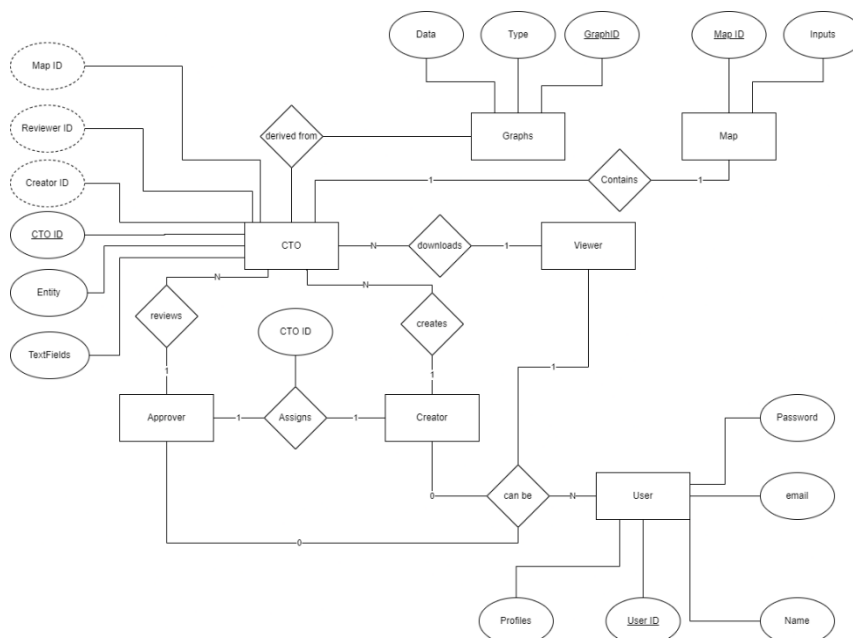


Figure 13 - ERD

This ERD represents the various entities and their attributes. It also shows how the user is always an observer, but can also be a Reviewer and Creator.

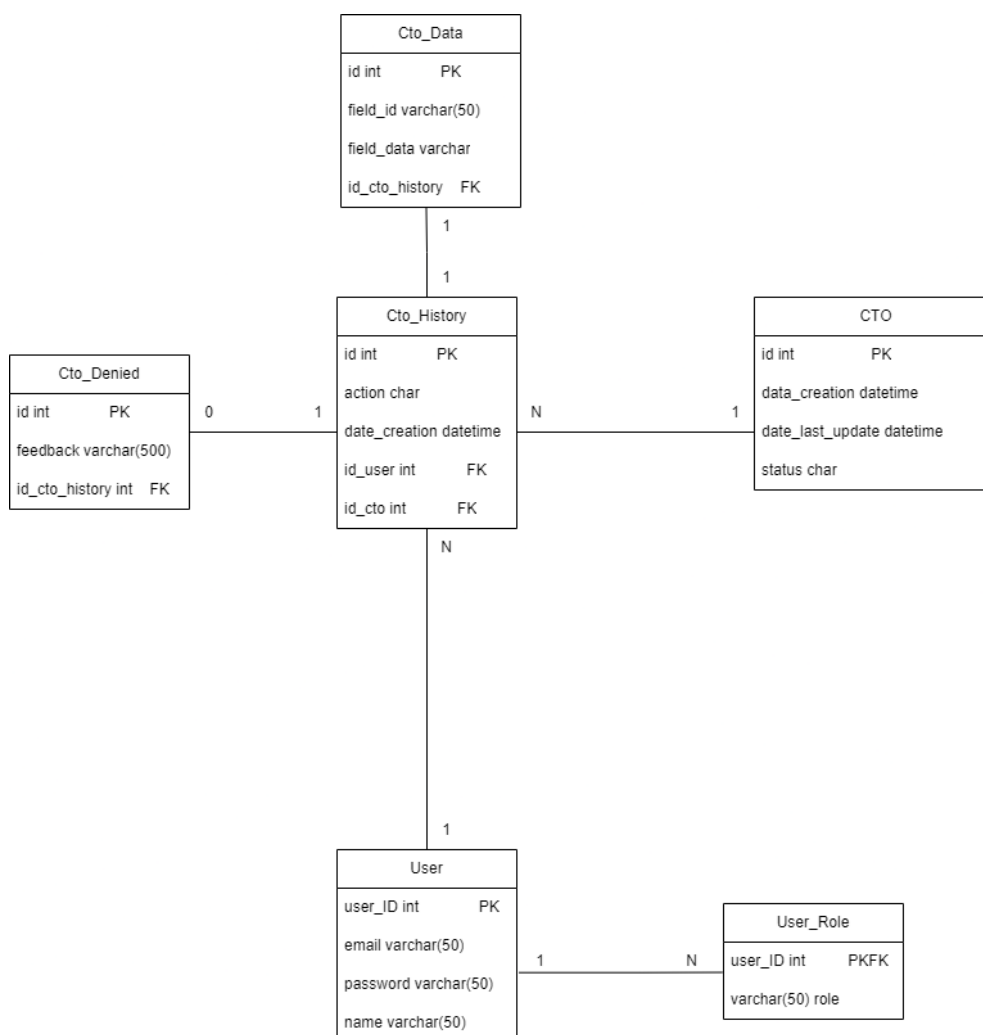


Figure 14 - Database Modeling

This model of the Database, shows the tables that the MySQL database will have and their respective attributes, foreign keys, and primary keys.

4.5 Structure

In this Section I display the Sitemap, which describes the Structure of the proposed webapp.

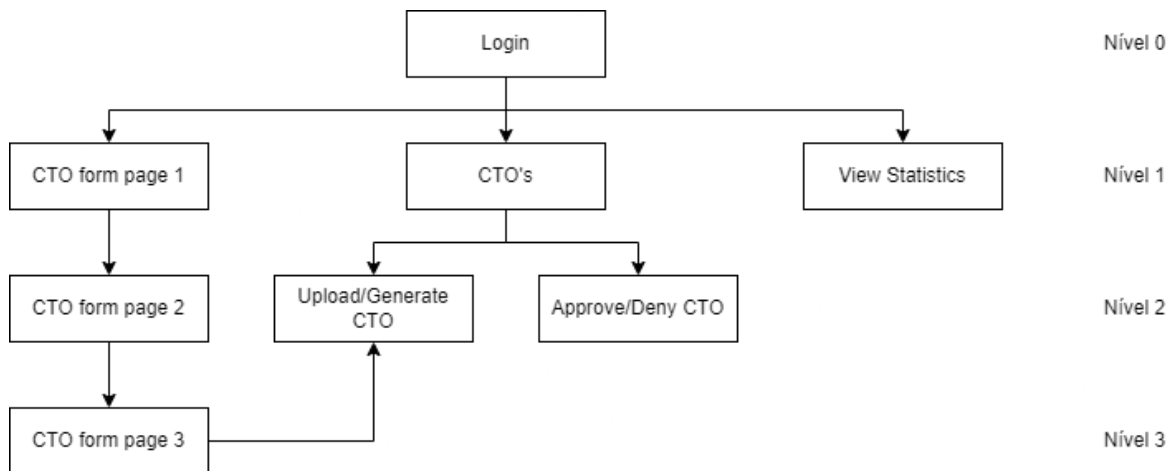


Figure 15 – Sitemap

This Sitemap, represents the interaction between pages for the proposed webapp.

4.6 Mockup

To be able to visualize our proposed solution, this section presents a pivotal element: the mockups. These graphical representations offer a view into the anticipated user interface, providing stakeholders with a clear preview of the Webapp's design and functionality. With a focus on enhancing user experience and system aesthetics, these mockups serve as a blueprint for seamlessly combining technology and usability.

The gateway to our emergency management system begins with a login screen. This visual presentation encapsulates both security and user-centric design principles.

The mockup displays the login interface for the Autoridade Nacional de Emergência e Proteção Civil (ANEPC). At the top, the ANEPC logo is on the left, and three links are on the right: 'Criar CTO' (green), 'CTO's' (orange), and 'Consultar estatísticas' (blue). Below these is a dark grey header bar with the text 'Iniciar Sessão' in white. The main form area contains two input fields: 'Email:' with a placeholder 'Introduza o seu Email aqui' and 'Password:' with a placeholder 'Introduza a sua Password aqui'. A dark grey button labeled 'Iniciar Sessão' is positioned below the password field. The footer section is divided into four columns. The first column contains the ANEPC logo, address (Avenida do Forte, 2794-112 Carnaxide Portugal), phone (214 247 100), coordinates (Lat: 38.720581 Long: -9.236277), and social media icons. The second column, 'SOBRE O SITE', includes a 'Mapa do site' link. The third column, 'AVISOS LEGAIS', includes 'Acesso à Informação' and 'Proteção de dados' links. The fourth column, 'SITES ANEPC', lists 'A Terra Treme', 'Aldeia Segura Pessoas Seguras', 'InfoRiscos', 'SIPE', 'SNPCE', and 'RNBP'. The footer also features the 'eportugal' logo, copyright notice '© 2023. Todos os direitos reservados ANEPC', and the 'Powered by QS QUANTICO SOLUTIONS' logo.

Figure 16 - Login Screen

Depicted is the Login Screen, containing an Email and Password field to fill in and a button to finalize the Login process.

The user gains entry to the first CTO creation page and upon successful login the user's name is noticeably shown at the top, affirming the logged-in status. Additionally, the current page is emphasized in green at the top, and displayed once more in white alongside the Login status for clear identification.

**AUTORIDADE NACIONAL
DE EMERGÊNCIA E PROTEÇÃO CIVIL**

[Criar CTO](#) CTO's Consultar estatísticas

Criar CTO 1/2 João Carval... ^

CTO N.*
N.º do CTO com o formato XXX/20XX (ex: 001/2023)
No caso de CTO com diferentes períodos de EAE, efetuar diferentes registos, adicionando ao número o algarismo referente ao período (ex: 001/2023/1, 001/2023/2, ...Etc.)

Automaticamente incrementa, baseado no ano e último CTO

Início*
Data e hora de início do período do CTO

MM/DD/YYYY hh:mm

Fim*
Data e hora de fim do período do CTO

MM/DD/YYYY hh:mm

Figure 17 - CTO creation 1

Page that depicts the CTO creation Form start, with the user being Logged in.

At the bottom section of the second CTO creation page, users are presented with three distinct functionalities. First, the option to navigate back to the initial CTO creation page is available, facilitating any necessary revisions. Second, a preview feature allows users to visualize how the CTO will appear before finalizing and releasing it for approval. Lastly, users can initiate the review process by selecting the corresponding option, simplifying the workflow for efficient decision-making.

Adicione Texto

Aos Comandos assinalados:
Adicione Texto

Determina-se ainda:
Adicione Texto

Deixe aqui a assinatura digitalizada

Escolher Ficheiro

Página anterior

Ver em PDF

Enviar para Aprovação

Vai ter um dropdown aqui ao lado, para escolher a quem é enviado, para rever o CTO (é só uma pessoa?)

Figure 18 - CTO creation 2

At the bottom of the second CTO creation page, users can navigate back to the initial page, preview the Chief Technical Officer's appearance before approval, and initiate the review process.

In the displayed CTO list page, different colors are used depending on who views it: Blue is used for CTOs that are still not published, Red is visible only to reviewers of unpublished CTOs, and Grey is used for published CTOs visible by all other users. The button design for actions includes an alternative version, presented in Annex III – Alternative Button Design CTO's, from which ANEPC will select.

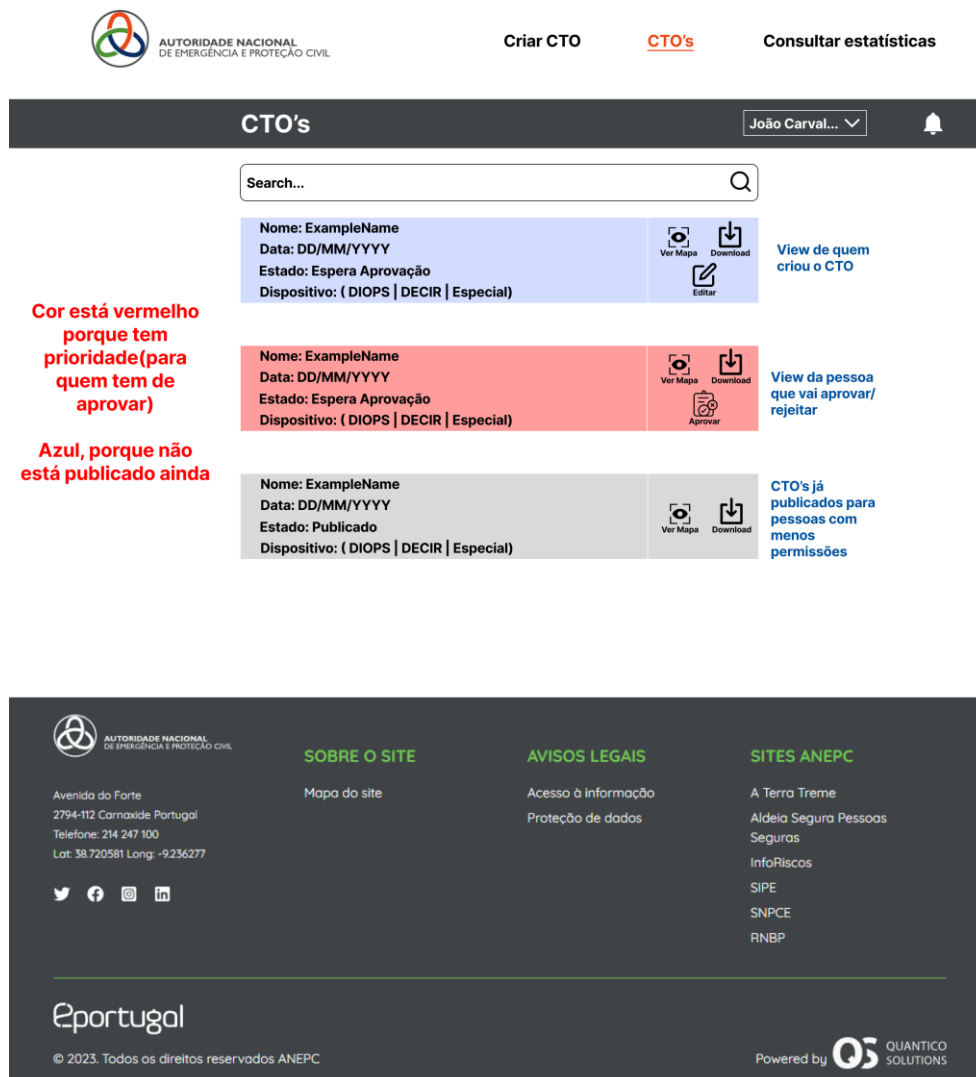


Figure 19 - CTO's

On the CTO page, different colors indicate various states that are viewed differently according to the level of permission of the User. Red-colored CTOs are visible exclusively to reviewers to convey urgency.

The statistics page features exemplary Bar and Pie charts, allowing ANEPC to choose the preferred statistics (to be defined). Additionally, a download button enables users to download a .csv file containing all the stored statistics from the database.

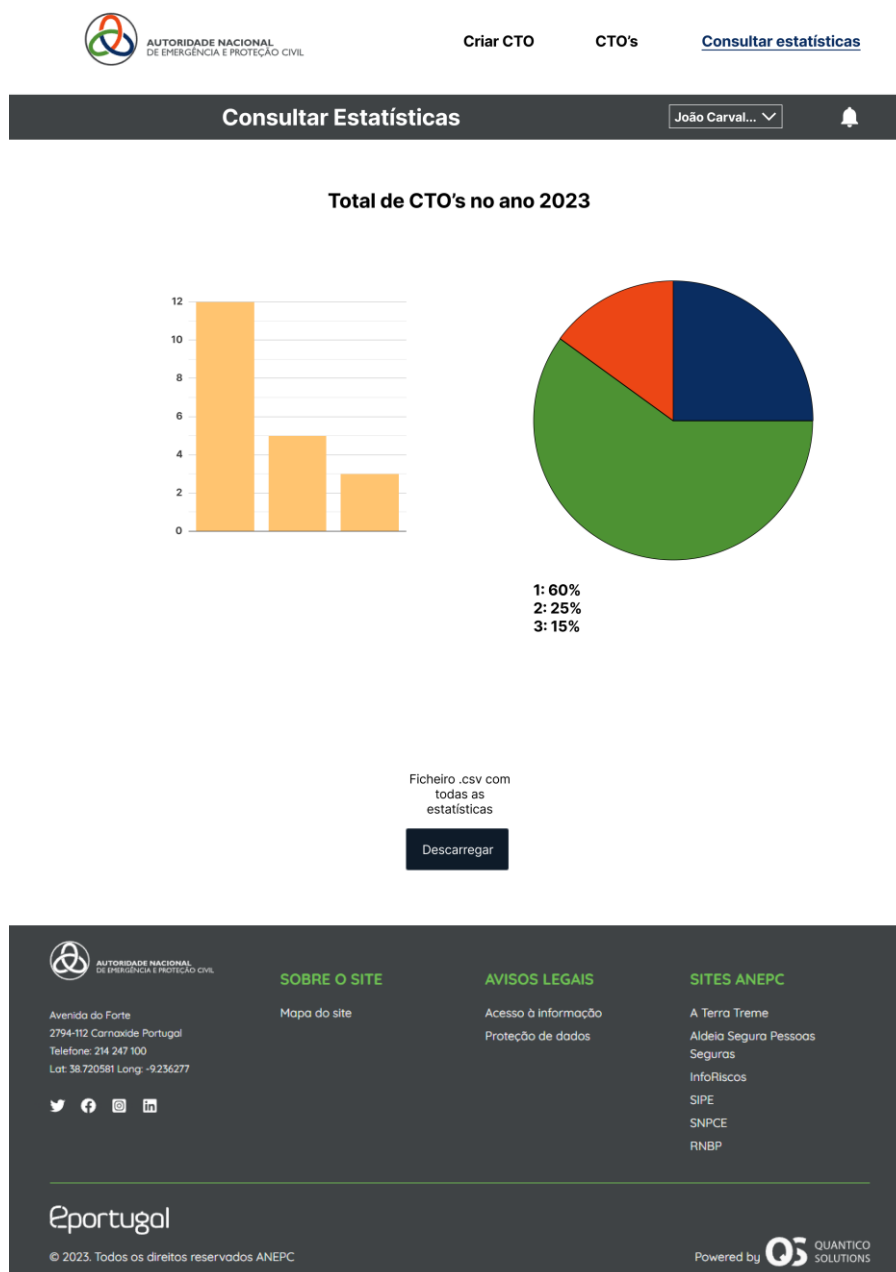


Figure 20 - Consultar Estatísticas

Statistics page with two charts and a download button.

5 Developed Solution

5.1 Introduction

The web application aims to address the challenges outlined in the preceding sections by leveraging advanced technological tools and frameworks. It focuses on strengthening preparations for emergency interventions and optimizing information management in the EPE system. The objective is to simplify communication, enhance administrative efficiency, and ultimately contribute to the mitigation of damage and preservation of human lives during emergency situations. This objective can be achieved through this new web application.

The following two links, are GitHub repositories, which show the projects that I have used to train, as to be able to implement all the tools I need when I start working on the TFC itself:

<https://github.com/a22104341/TrainingSpringbootCopy>

<https://github.com/a22104341/PDFcreatorTest>

This Link gives you access to the video of the development environment:

<https://www.youtube.com/watch?v=LGBZvOZV8n4>

This Link gives you access to the Prototype created within Figma:

<https://www.figma.com/file/ggBsFvB0JEIRj3n1livW2L/Mockup-V2?type=design&node-id=0%3A1&mode=design&t=BWjRQsFpaGPzx4su-1>

The following Link is the link to access the GitHub repository with the code that was developed during this TFC:

<https://github.com/DEISI-ULHT-TFC-2023-24/TFC-DEISI11-Registration-and-Monitoring-of-Civil-Protection-Emergency-Levels>

In the subsequent sections, we delve into a comprehensive exploration of the proposed solution. Following the introductory overview in Section 5.1, we provide insights into the architectural framework in 5.2. This includes a detailed illustration of the solution's architecture, highlighting key components and using visual aids to clarify the technological perimeters at play. In Section 5.3, we clarify the array of technologies and tools applied in the development, shedding light on their individual roles and justifications. Additionally, Section 5.4 presents the practical implementation aspects, outlining the required computational, storage, and network resources essential for a robust and efficient productive environment. Furthermore, Section 5.5 explores the TFC, showcasing how diverse disciplines and scientific areas from the course curriculum synergize with chosen technologies. This

highlights the fusion of academic insight with technological expertise in crafting an efficient and user-centric solution. Each part of the section adds a unique perspective to our understanding of the proposed CTO creation application, aligning closely with the identified requirements and regulatory guidelines.

5.2 Architecture

The architectural of our solution encompasses various components vital for effective emergency management. Illustrated in the Figure 21 - Architectural Image 1, these components include the web backend, frontend models, database structures, and additional elements essential for a comprehensive and cohesive system. This visual helps to illustrate the complex technological perimeters involved in our solution.

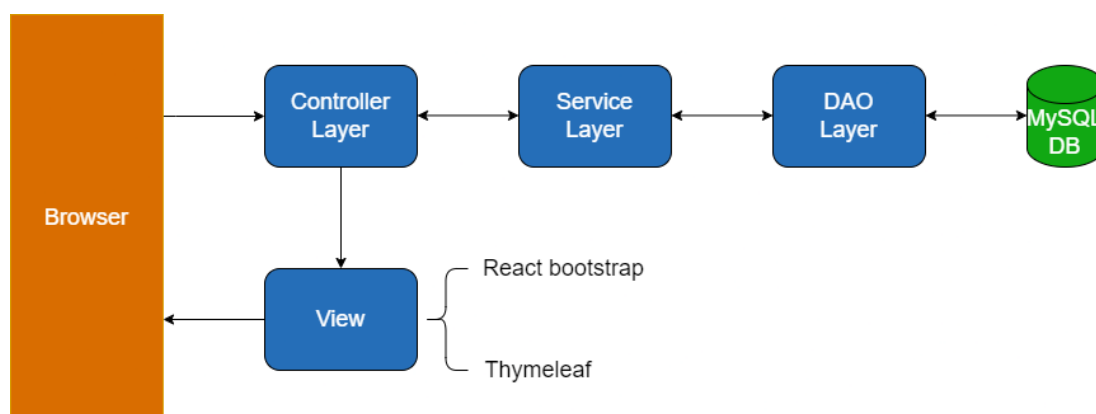


Figure 21 - Architectural Image 1

This Architectural Image depicts the interaction between various layers such as the View, Controller, Service and DAO.

In the project's architecture, the DAO Layer operates at the lowest level, directly interacting with the database and managing objects representing database tables. It handles operations like adding users to the database. Above the DAO, the Service Layer orchestrates functions such as login and web service calls. The Controller Layer processes HTTP calls during website interactions on the browser, determining which layer can handle each action. For instance, when a user signs in, the Controller identifies the corresponding function in the Service Layer, which, in turn, interacts with the DAO Layer to retrieve information from the database. If the login is successful, the Controller instructs the View to render an HTML page indicating completion of the action.

5.3 Used Technologies and Tools

To develop the web application, we used several technologies and tools, namely Spring Boot (Java), Thymeleaf, MySQL Database, Maven, npm (Node Package Manager), GitHub. The logic used to select them, including a brief justification aligned with the requirements identified, is described below.

- **Spring Boot (Java):** Selected as the web backend framework, Spring Boot ensures the development of a robust and scalable server-side application that seamlessly aligns with the project's requirements for stability and performance. Its versatility and extensive features make it a reliable choice for managing emergency levels, incident reports, and resources.
- **Thymeleaf:** Employed for the frontend, Thymeleaf, when used with Spring Boot, accelerates development by providing a robust and versatile server-side template engine. This allows for the dynamic generation of HTML content, enabling developers to create rich, dynamic web pages. Thymeleaf ensures seamless integration with Spring Boot, facilitating the binding of model data to the view layer. This not only aids in the user interface creation process but also ensures a visually appealing and user-friendly design, enhancing the overall user experience.
- **MySQL Database:** Chosen as the database management system, MySQL facilitates efficient data storage and retrieval critical for managing emergency levels, incident reports, and resources. Its reliability and performance contribute to the ideal functioning of the application's backend.
- **Maven:** Utilized as a build automation tool, Maven streamlines the project's build lifecycle and dependency management, enhancing overall efficiency. For example, Maven simplifies the compilation, testing, and packaging processes, ensuring a structured and organized development workflow.
- **npm (Node Package Manager):** Integrated for managing frontend dependencies, npm facilitates the integration of various libraries and packages, contributing to the overall agility of the development process. This means that developers can easily add, update, and manage external resources, optimizing the frontend development workflow.
- **GitHub:** As a version control platform, GitHub provides a collaborative space for developers, fostering transparency, accountability, and organized development practices. Specifically, the codebase will be deposited on GitHub, enabling version tracking, collaboration, and a centralized repository for the project.

- **Figma:** Introduced for the design and prototyping phase, Figma enables collaborative interface design and iterative prototyping, ensuring a user-centric approach to the development of the solution.
- **Apache:** Often used as a web server, Apache plays a crucial role in serving static content, handling incoming HTTP requests, and acting as a reverse proxy. Its flexibility and extensive configuration options make it an ideal choice to enhance the performance and security of web applications. For this project, Apache can be configured to handle tasks such as load balancing and SSL termination, ensuring efficient and secure communication with clients.
- **Tomcat:** While Apache handles general web server tasks, Tomcat specifically serves as a servlet container for Java-based web applications. In the context of this project, Tomcat hosts the Spring Boot backend, managing the execution of Java servlets and providing a scalable environment for processing dynamic content. The combination of Apache and Tomcat allows for a comprehensive web application infrastructure, where Apache efficiently handles static content, while Tomcat manages the execution of dynamic, Java-based components.

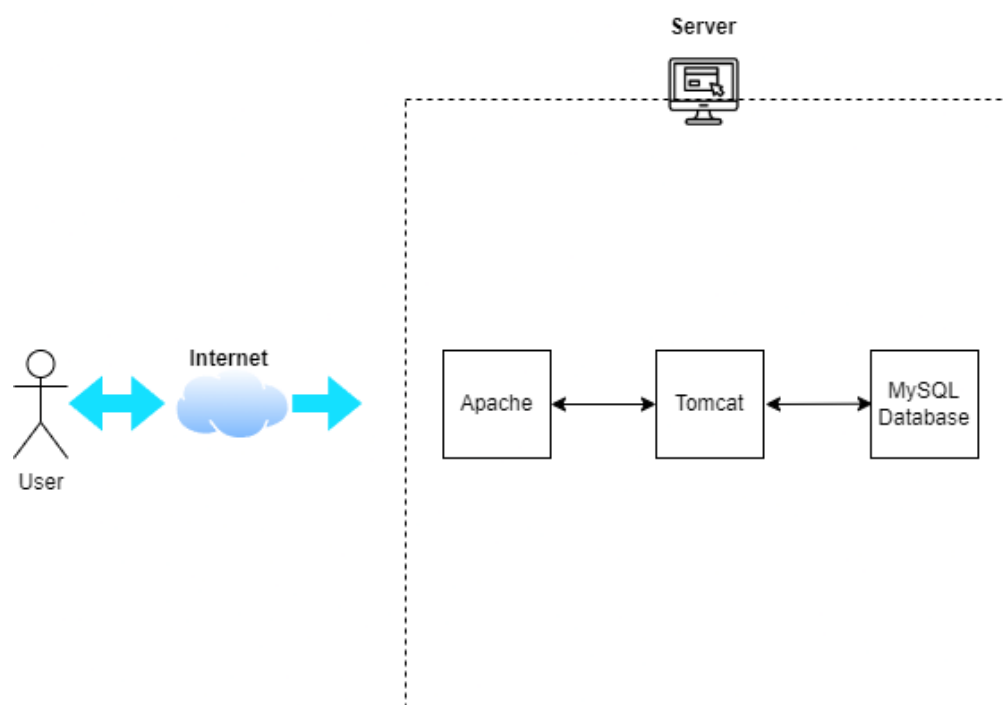


Figure 22 - Architecture Diagram

Architecture Diagram, depicting a server in which the communication between Apache, Tomcat and MySQL Database is clear and the communication, between the User, Internet, and Server.

5.4 Implementation

The implementation of the web application for EPE managed by the ANEPC requires an agile and efficient productive environment. The following sections outline the necessary resources for the deployment and operation of the solution:

Computational Resources:

In terms of computational resources, this project necessitates a server equipped with Apache, Tomcat, and a MySQL Database. The collaboration among these three resources is integral, with Apache facilitating the availability of the web application on the internet, allowing users to access and interact with the system. Tomcat hosts the Spring Boot backend, implementing project functions, while the MySQL database stores all pertinent information, facilitating data management. A representation of this is visible through the Figure 22 - Architecture Diagram, depicted above.

Storage Resources:

For this project, we need to allocate sufficient storage space for the MySQL database to store incident reports, resource data, and other relevant information. Furthermore, we require quite a bit of storage capacity to provide ample space for current requirements and allow for future expansion as the system grows, ensuring a sustained storage solution that accommodates evolving needs.

Security Measures:

When it comes to security, we will implement measures such as firewalls, SSL certificates, and regular security audits to safeguard sensitive emergency-related data, through Spring boots security layer.

By adhering to these resource requirements, the web application can be deployed in a productive environment that ensures reliability, scalability, and security. This approach enables efficient management of emergency situations through simplified communication, enhanced oversight, and effective resource allocation.

5.5 Scope

In this TFC, I aimed to harness the combined strengths of Java, Spring Boot, Thymeleaf, Figma, and MySQL technologies. My selection of these tools stems from the foundational knowledge acquired from specific courses throughout my academic journey.

5.5.1 Java:

Java served as the primary foundation for this project, reflecting the proficiency I acquired in "Programming Languages II," where it was the main language of instruction and application. Beyond ensuring the backends' robustness and reliability, Java's expansive global community and longstanding reputation in the tech industry confirm its selection. Its widely acknowledged "write once, run anywhere" principle underscores its platform independence and reinforces its significance in major enterprises, including Google and Amazon.

5.5.2 Spring Boot and Thymeleaf:

My experience in "Web Programming" was influential in the decision to integrate Spring Boot and Thymeleaf. While the course primarily used Django as a framework, the essential web development principles I learned there guided my exploration into Spring Boot for backend development and Thymeleaf for the frontend. Merging the Java knowledge from "Programming Languages II" with the web techniques from "Web Programming" ensures a cohesive integration of Spring Boot and Thymeleaf, leading to an efficient website. Thymeleaf's community-driven approach and its adoption by companies like Trivago and Lufthansa emphasize its prominence in frontend technologies. Concurrently, Spring Boot's efficiency in development and its preference for convention over configuration establish it as a preferred tool for backend operations.

5.5.3 MySQL:

The "Databases" course introduced me to SQL queries and relational databases. Here, MySQL takes a central role for database management, ensuring efficient data storage, retrieval, and management. Its reputation as a premier relational database management system, bolstered by a robust global community, underscores its importance for various organizations, from startups to tech giants.

5.5.4 Figma:

When designing a user-focused UI/UX, the principles learned in "Human-Machine Interaction" are paramount. Figma is chosen as the design tool due to its user-friendly interface and effective implementation capabilities. The insights from "Human-Machine Interaction" will be applied rigorously to craft interfaces that champion human-centered design, ensuring that each user interaction is intuitive, efficient, and responsive.

By integrating the teachings from these diverse courses with the real-world strengths of the chosen technologies, this TFC sought to create a solution that combines academic insight with technological capability, with a strong emphasis on user-centricity and efficiency.

6 Testing and validation plan

Based on the objectives that were set out in 4.1 Requirements gathering and analysis, the following two chapters will detail a rigorous testing regimen to verify the expected functionality and quality of the aforementioned objectives.

6.1 Requirement Tests

The functional requirements were defined and accepted by ANEPC and are detailed in 4.1.1 Functional Requirements.

For the quality of the tests to be upheld, certain conditions had to be met:

- The university let me use its servers, to perform tests for my web application.
- ANEPC disposed of their time to present the final product
- Some users at ANEPC had to test the application by simulating various real-world scenarios, some examples of these are in the following table
- ANEPC gave feedback in a timely manner, so that I could fix any found issues, before the end of this TFC.

The Table 1 - Requirement Tests summarizes some of tests executed by me and requested to be tested by ANEPC. Respective titles, descriptions, requirements and expected results are shown. The completion and correct functioning of the web application based on these tests will display the correct functionality of the application.

Table 1 - Requirement Tests

Title	Description	Requirements	Expected Result
Authentication	Users Log into the website using their email and password.	R01	User can access the websites features, which are depending on their profile. User is only able to login if the credentials were filled out correctly.
Logout	Users that are already signed in, click on their name and then the Logout button.	R02	User loses access to all features of the website, gets redirected to the Login page.
CTO form	User fills out the form, trying different inputs and dropdown options.	R03, R05	User is only able to go to the 2 nd and 3 rd pages or the form if all fields in the previous pages of the forms were filled out correctly. All the information filled out by the user is saved correctly within the Database.

PDF creation	Upon submission of the form, the user clicks on the download button to download the CTO in PDF form.	R03, R10	The file gets generated and is downloadable by the user. The PDF was correctly generated, containing all the information the user filled out.
Map creation	The user fills out the multiple-choice options and clicks on the generate map button.	R04	The map is generated, based on the user's choices.
CTO List	User opens the CTO List, without having created a CTO. User creates a CTO and views the CTO List.	R06	Only approved CTOs are properly displayed on the website for every user. Users that created or must review a CTO, can see that CTO on the CTO List.
Review CTO	User presses on Review on the CTO that must be reviewed.	R07	User automatically downloads that CTO and is prompted with a page that lets him approve or deny the submission of that CTO. If the user approves it, its status changed to approved and now all users can see it on the CTO List. If the users denies it, he is asked to fill out a field to give feedback, on what needs to be changed.
Edit CTO	User clicks on Edit CTO.	R08	All Fields are filled out like they were on submission and the user gets a feedback field, that displays the text the reviewer left.
Tables	User clicks on Statistics Page.	R09	Tables with certain statistics are displayed. Tables are up to date, based on the information of all CTOs.
CSV creation	User goes onto Statistics Page and clicks on download .csv	R11	That button is only displayed to users with sufficient permissions. A .csv file is generated with all statistics that were created from within the Database.

7 Method and Planning

The project advanced through three key phases: Planning/Learning, Implementation, and Testing. Complementing these stages, the creation of four essential reports acted as a compass, guiding the project's trajectory. For a visual overview of tasks and timelines, refer to the following Gantt chart illustrating the strategic execution plan for the project.

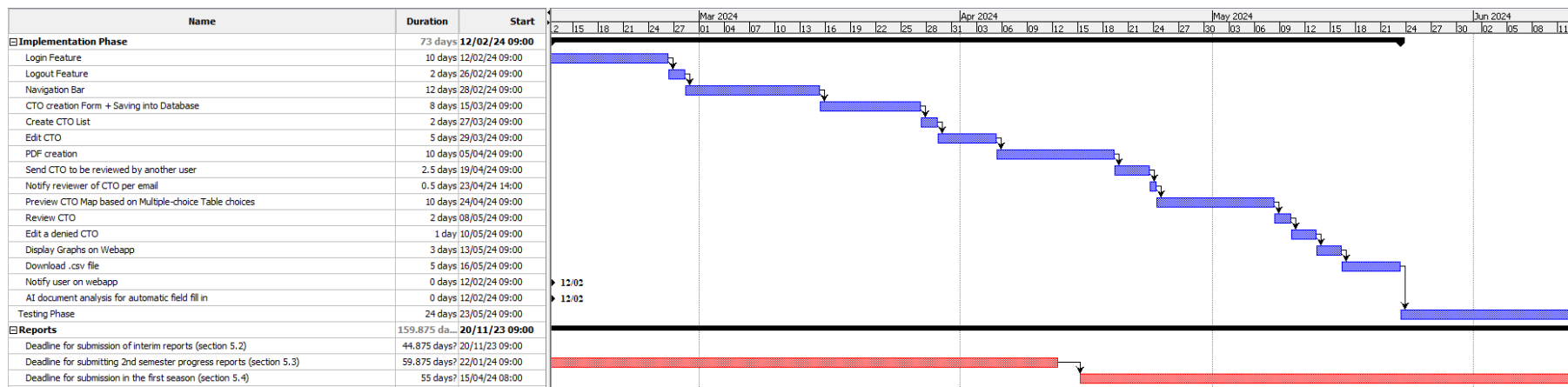


Figure 22 - Gantt chart

Gantt chart illustrating the timeline-based allocation of tasks outlined on the left, with task names updated in accordance with the Functional Requirements.

The subsequent Implementation Phase started upon completion of the mid-term evaluations in 2024 and was extended until May 30th, 2024, the focus was shifted towards the tangible development of the website. During this phase, my primary objective was to methodically implement every essential requirement outlined in the Functional Requirements section, prioritizing those deemed more critical than merely "nice to have". Based on the experience gained in the Planning/Learning phase, I have assigned estimated durations for each requirement's implementation, carefully considering the order of execution. While I haven't precisely aligned the timeline until the conclusion of the TFC duration, I intentionally included a buffer to account for potential delays or unforeseen challenges.

The phased approach initiated with the implementation of the authentication process, followed by comprehensive handling of CTO creation, management of CTO publishing processes, and ultimately integrating the statistics section into the web application.

To date, the authentication process and CTO publishing was successfully implemented. Due to unforeseen issues with the integration of React bootstrap with Spring Boot, there was a need to remake the form creation process. This has delayed the progress of the project, which I compensated for later on. This required redistribution of tasks that are depicted in the final Gantt Chart depicted above.

The Testing Phase will run from April 17th 2024 to June 14th 2024 and will be focused on a thorough and rigorous testing regime. The objective is to diligently assess the website for functionality, security, and overall usability.

Embedded in the broader project structure were four vital reports. The plan dictates that the first semester progress report was ready by November 19th 2023. This was followed by an interim report due on January 19th 2024. Subsequently, the second semester progress report was set for submission by April 14th 2024. The final report will be submitted by June 28th 2024.

The proposed calendar, as shown in Figure 22 - Gantt chart corresponds to the current project progression. As the project is in its final stages, only minor adjustments might be required.

Throughout the execution of this project, this final phase progressed better than the former ones. In earlier planning phases, I underestimated the time needed for learning new technologies, alongside the time that other classes took. In the last planning phase, I also encountered an issue with React bootstraps compatibility with Spring boot, which delayed implementation substantially until the second interim report. This delay impacted on the testing period, that had to be shortened. Nevertheless, this was compensated, and completion of the web application was achieved successfully.

8 Results

This TFC set the goal to develop a Web application for ANEPC that could support their emergency management. The application developed most features that were defined at the beginning. Our web application has a form to create a CTO automatically, it saves all created CTOs, and has a statistics page that permits retrieving past data efficiently. These features are locked behind a login, and different users have different permissions depending on their role. The CTO is generated in pdf format and includes the information that is entered in the form by the user. All information is saved in a database, which permits generating statistics and the corresponding tables. As an option, the user can also generate a .csv file with predefined information, according to specifications from ANEPC.

8.1 Installation in the Production Environment

Development took place on a local machine, and we deployed the final application on the university's server. The web application is now successfully running on the server, with the database also hosted on the same server. We gave ANEPC access to the web application via the following link: <https://labs.deisi.ulusofona.pt/anepc>

In addition, we also supplied them with 4 different logins corresponding to users with different roles. This enabled ANEPC to test the application independently and simulate different scenarios in combination with different roles. These were as follows:

admin@anepc	(Approver role)
admin@anepc2	(Approver role)
creator@anepc	(Creator role)
viewer@anepc	(Viewer role)

For all the common password is: 123

8.2 Improvement of the Application

We met ANEPC after their tests and were asked for the implementation of features that were considered helpful, which we implemented successfully. We now include automatic numbering of the CTOs. When the year changes, the count will reset, just like ANEPC asked. Another feature is how the tables on the second page of the form function. The “Comando Nacional” table now automatically selects the most serious EPE level (furthest to the right). The same also happens for the first line of each table. Clicking on the color of the table at the top should select all choices in that table with that same color and all tables should be preselected as green at the beginning. These functionalities were also implemented.

We had another meeting with ANEPC, to discuss the final version of the application, before the final tests to be run by them. During this meeting, we were asked to change the name of the state from a denied CTO, from “Negado”, to “Rejeitado”. In addition, we were asked to change the title of one of the columns that is created in the .csv file from “CAS”, to “Aprovado por:” (Approved by). During the

demonstration and testing of this .csv file generation we realized that the name of the person that created the CTO was being saved, instead of the name of the person who approved its submission. All issues were corrected following this meeting.

Next, we sent ANEPC the link to access the web application that is being hosted on the University's servers, alongside the login to three different profiles. Each of these profiles corresponds to one possible role, enabling the simulation of different users with different permissions. This strategy was done to replicate a more realistic use of the web application. Finally, we also sent them a google docs file, to document potential issues encountered during tests to ease feedback, that is necessary to optimize the final version of the project.

Upon completing these tests, ANEPC identified 3 issues. The first was that the time saved in the CTOs was in the wrong time zone. This had been found in the past, but persisted in the version that was in the university's server. The second issue, were the colors chosen to color the tables and EPE map. The third issue was the type of font used that was not the one specified for the pdf file. All these issues were corrected following feedback.

The functionality of some of these features is visible in the demonstration video that is in 5.1 Introduction.

Here are some images to show the comparison between the old and the new improved versions after the tests:

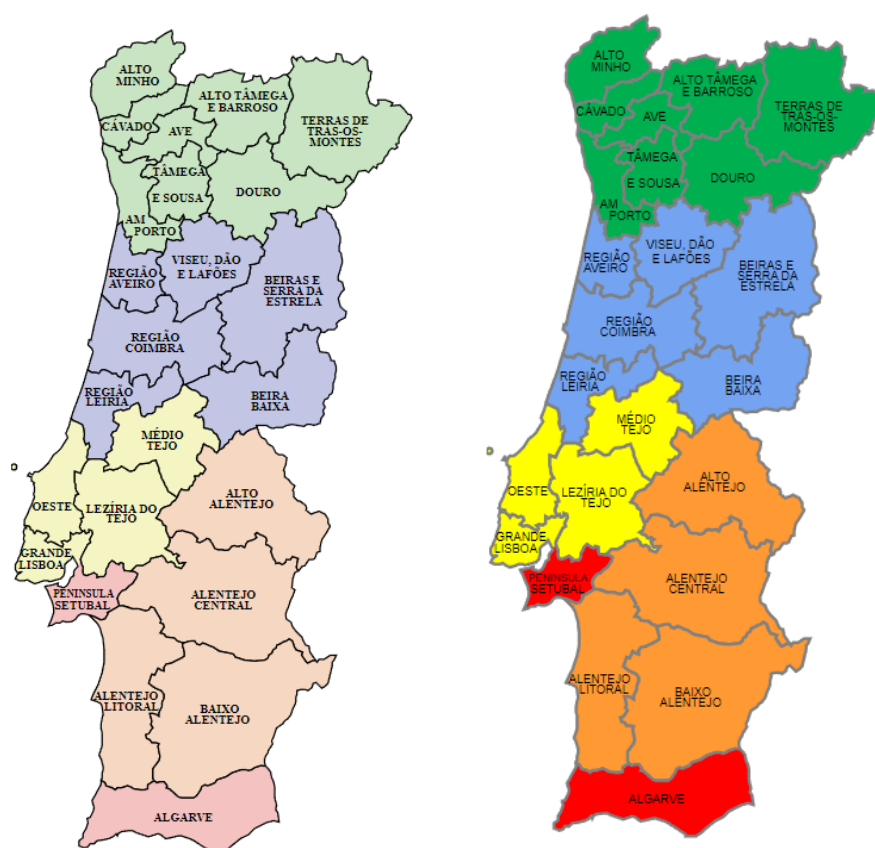


Figure 23 - old vs new colors of EPE map

2 - EFEITOS EXPECTÁVEIS

Condições meteorológicas adversas, com precipitação [definição do tipo de precipitação] sendo previsto nesse período: a. Ocorrência de inundações em zonas urbanas, causadas por acumulação de águas pluviais por obstrução dos sistemas de escoamento ou por galgamento costeiro; b. Ocorrência de cheias, potenciadas pelo transbordo do leito de alguns cursos de água, rios e ribeiras; c. Instabilidade de vertentes, conduzindo a movimentos de massa (deslizamentos, derrocadas e outros) motivados pela infiltração da água, fenómeno que pode ser potenciado pela remoção do coberto vegetal na sequência de incêndios rurais, ou por artificialização do solo; d. Piso rodoviário escorregadio devido à possível formação de lençóis de água; e. Dificuldades de drenagem em sistemas urbanos, nomeadamente as verificadas em períodos de preia-mar, podendo causar inundações nos locais historicamente mais vulneráveis.

Figure 24 - old format of text

2 - EFEITOS EXPECTÁVEIS

Condições meteorológicas adversas, com precipitação [definição do tipo de precipitação] sendo previsto nesse período:

- a. Ocorrência de inundações em zonas urbanas, causadas por acumulação de águas pluviais por obstrução dos sistemas de escoamento ou por galgamento costeiro;
- b. Ocorrência de cheias, potenciadas pelo transbordo do leito de alguns cursos de água, rios e ribeiras;
- c. Instabilidade de vertentes, conduzindo a movimentos de massa (deslizamentos, derrocadas e outros) motivados pela infiltração da água, fenómeno que pode ser potenciado pela remoção do coberto vegetal na sequência de incêndios rurais, ou por artificialização do solo;
- d. Piso rodoviário escorregadio devido à possível formação de lençóis de água;
- e. Dificuldades de drenagem em sistemas urbanos, nomeadamente as verificadas em períodos de preia-mar, podendo causar inundações nos locais historicamente mais vulneráveis.

Figure 25 - new format of text

Este é um documento de carácter **RESERVADO** que não se destina à divulgação pública, tendo como objectivo a transmissão de determinações operacionais às entidades que integram o Sistema Integrado de Operações de Protecção e Socorro (SIOPS), para fazer face a um determinado evento expectável, limitado no tempo e no espaço. Contém ainda informação de base sobre o evento em causa, os efeitos expectáveis e transmite informação sobre as medidas de prevenção e autoproteção a divulgar localmente à população.

Figure 26 - old font

Este é um documento de carácter **RESERVADO** que não se destina à divulgação pública, tendo como objectivo a transmissão de determinações operacionais às entidades que integram o Sistema Integrado de Operações de Protecção e Socorro (SIOPS), para fazer face a um determinado evento expectável, limitado no tempo e no espaço. Contém ainda informação de base sobre o evento em causa, os efeitos expectáveis e transmite informação sobre as medidas de prevenção e autoproteção a divulgar localmente à população.

Figure 27 - new font

9 Conclusion and Future Work

In a reality where emergency settings at a national level are the main concern, efficiency and reliability of processes are key in effective decision-making. This guarantees timely responses and streamlined communication during emergencies, which are crucial to mitigate damage and preserve human lives. ANEPC is at the center of receiving emergency-related information at national level and coordinating the action of different authorities. At the center of communication are CTOs, which include the information related to the emergency, and state the details concerning emergency management. Currently, the CTO generation is a labor-intensive process that consumes a significant amount of time and human resources. There is difficulty in data collection because there is no centralized or digitized system, which can lead to discrepancies and/or missing information. Sharing information internally, as well as externally with collaborating organizations is difficult because it relies on human action and there are no automated processes. In addition, there is a need for a designated database to store created CTOs, as well as a dedicated statistical tool to permit evaluating and analyzing the data included in them. Security is another pressing concern.

Here, I report on the development of a new Web application aimed at empowering ANEPC to oversee and administer emergency levels, incident reports, and resources. This application is greatly transformative as it brings automation to several steps. Only Authorized Users can access the application via login with a username and password. Users have different profiles corresponding to one of three possible roles, each with different levels of permissions. The application now permits an efficient and automated generation of CTOs dependent on the insertion of information in a form. This eases the sharing of information internally but also with other authorities. The reduction of human action reduces potential sources of error. Created CTOs are all stored in a database, which can be consulted to retrieve past data and analyze it with statistic tools.

While this solution is a major step forward that brings the promise to contribute substantially for a novel reality in emergency management in Portugal, it also keeps the possibility for future expansions. One possibility could be to implement an AI tool to help prefill several fields of the form based on files from external sources, which ANEPC currently needs to interpret. Another feature could be to add a section that can be customized by the User for specific purposes that may not fit the predefined sections. Finally, a suggestion would be to permit the digital signature of the CTO directly in the web application.

The State of Special Readiness (*Estado de Prontidão Especial*, EPE) managed by ANEPC aims at strengthen preparatory actions for interventions in emergency situations and diminishing their impact. This system establishes a state of readiness to act upon various situations that include fires and floods, by strategically deploying human and material resources. To this end, information management in a timely and effective manner is crucial. Here, the possibility to improve the current capacity of ANEPC to manage emergency situations is a reality that can rely on a novel website application that automates several of the steps involved in emergency management situations.

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Annex I – Work Progress (Intermediate Report)

The project advanced through three key phases: Planning/Learning, Implementation, and Testing. Complementing these stages, the creation of four essential reports acted as a compass, guiding the project's trajectory. For a visual overview of tasks and timelines, refer to the accompanying Gantt chart, illustrating the strategic execution plan for the project.

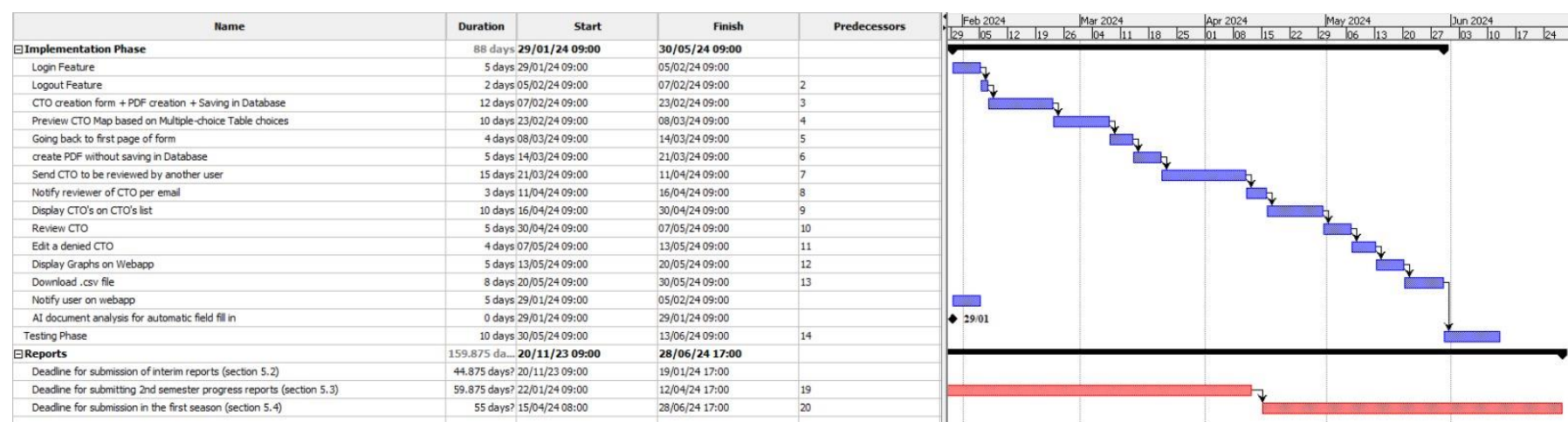


Figure 28 - Gantt chart

Gantt chart illustrating the timeline-based allocation of tasks outlined on the left, with task names updated in accordance with the Functional Requirements.

The subsequent Implementation Phase, was planned to start upon completion of the mid-term evaluations in 2024 and extend until May 30th, 2024, shifted the focus towards the tangible development of the website. During this phase, my primary objective was to methodically implement every essential requirement outlined in the Functional Requirements section, prioritizing those deemed more critical than merely "nice to have". Based on the experience gained in the Planning/Learning phase, I have assigned estimated durations for each requirement's implementation, carefully considering the order of execution. While I haven't precisely aligned the timeline until the conclusion of the TFC duration, I intentionally included a buffer to account for potential delays or unforeseen challenges.

The phased approach initiated with the implementation of the authentication process, followed by comprehensive handling of CTO creation, management of CTO publishing processes, and ultimately integrating the statistics section into the web application.

Despite successfully adhering to the timelines outlined in the Testing/Learning Phase in the interim progress report, I encountered a delay in commencing the Implementation Phase. Unforeseen project commitments necessitated a temporary shift in focus during the designated timeframe for starting the implementation and testing, impacting the projects timeline. This new timeline is reflected in the new version of the Gantt Chart Figure 31 – 1st Mockup CTO creation.

The subsequent Testing Phase ran from May 30th 2024 to June 14th 2024 and focused on a thorough and rigorous testing regime. The objective was to diligently assess the website for functionality, security, and overall usability.

Embedded within the broader project structure were four vital reports. The plan dictated that the first semester progress report would be ready by November 19th 2023. This was followed by an interim report due on January 19th 2024. Subsequently, the second semester progress report was set for submission by April 14th 2024. The project's timeline indicated that the final report will be submitted by June 28th 2024.

The proposed calendar, as shown in Figure 28 - Gantt chart, provides a structured plan for the project's progression. As the project was in its early stages, it was predicted that there would be a need for adjustments and modifications that were to be integrated as the project execution progressed.

To date, the navigation, authentication and CTO creation processes were successfully created. Unfortunately, there were unexpected problems between Spring Boot and React JS, complicating the adherence to the plan. Whilst being less progress than planned to this point, having more free time to dedicate to the project at this point, compensated for some of the lost time.

Annex II – Work Progress (Interim Progress report)

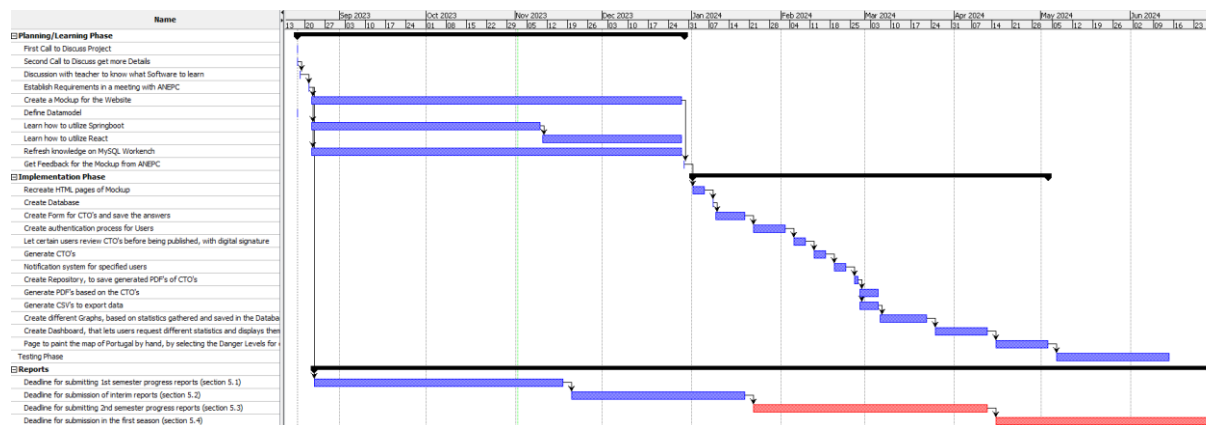


Figure 29 - Gantt Interim Progress report

This Gantt Diagram displays the planning made for the TFC, during the Interim Progress report stage.

I have successfully adhered to the timeline until the commencement of the Implementation Phase, which was predicted to begin this semester. Challenges encountered during the planning phase included accurately estimating the duration of specific tasks. This complexity has been mitigated by gaining insights from various tasks undertaken during the Planning/Learning phase, providing a clearer understanding of the time required for different types of tasks.

Another challenge involved accounting for time dedicated to projects for other classes, impacting the availability for this assignment. Despite these challenges, my supervisors have played a crucial role in providing guidance, clarifying concepts, and directing me to relevant tasks and resources for the project.

To document daily progress and activities, I have maintained a text file where I record the date and tasks worked on whenever I work on the TFC. While I haven't documented the exact time spent on each task of my workflow, each entry in the document represents a minimum of one hour, ranging up to twelve hours. As I didn't track the time spent in the past, I can't provide specific details on the duration of each day's work, but I ensured that each entry reflects a meaningful contribution to the project. The contents of this text file are in the .

Annex III – Alternative Button Design CTO's

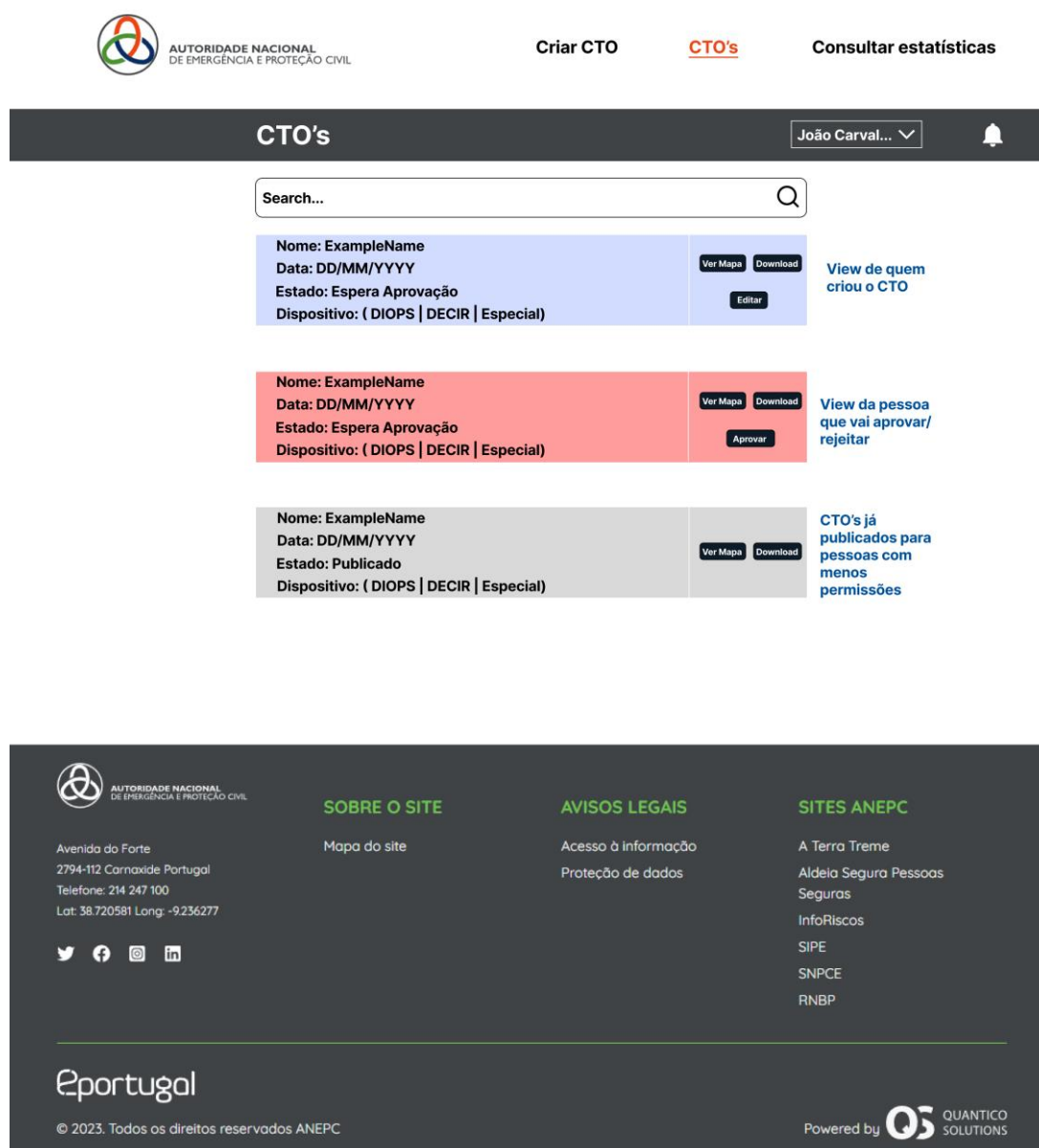


Figure 30 - CTO's Alternative Design

This Image displays an alternative design for the button design on the CTO's page.

Annex IV – Mockup (Interim Progress Report)

The foundation for the mockup design began with the integration of the existing navigation bar and footer from ANEPC's official website, found at [PROC23]. This ensured that the mockup retained the core branding elements and provided a consistent user experience. Additionally, a specific form was incorporated into the mockup, as provided by ANEPC. Each of these components were carefully chosen and integrated to craft a cohesive mockup representation. Next, I add some representative figures depicting the mockup.

A



The mockup displays the top navigation bar of the ANEPC website. On the left is the ANEPC logo and name: "AUTORIDADE NACIONAL DE EMERGÊNCIA E PROTEÇÃO CIVIL". To the right are three links: "Criar CTO" (green), "CTO's" (orange), and "Consultar estatísticas" (blue). Below this is a dark grey header bar with the text "Criar CTO" on the left. On the right of this bar are three elements: a user profile dropdown showing "João Carval..." with a downward arrow, a "Iniciar sessão" button, and a notification bell icon with a red "1" badge. Below the header bar, the form for "Criar CTO" is shown. It starts with the label "CTO N.º*" in bold. Below this is a text input field with the placeholder "Insira um Numero". Further down is the label "Início*" in bold. Below this is a text input field with the placeholder "Data e hora de início do período do CTO". At the bottom of the form are two date and time pickers. The first picker is for the date, showing a calendar icon, the placeholder "MM/DD/YYYY", and a downward arrow. The second picker is for the time, showing a clock icon, the placeholder "hh:mm", and a downward arrow.

B

Comando Regional Algarve

	Verde	Azul	Amarelo	Laranja	Vermelho
CREPC Algarve*	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CSREPC Algarve (Faro)*	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

CTO em PDF

Drop file here or select file (pdf, doc, docx, xls, xlsx, pptx, ppt, txt)

Enviar

C



Figure 31 – 1st Mockup CTO creation

A) Depicts the beginning of the webpage, showing the first sections that are to fill in when creating a CTO.

B) Shows “Algarve” as an example of one of the possible regions that needs to be selected, and the possible colors that the user must choose according to the current emergency level.

C) Footer of the web application.

Access to this web application is restricted to trusted users, which require authentication. This will be incorporated via a login page, ensuring secure access for users, and aligning with ANEPC's branding.

AUTORIDADE NACIONAL DE EMERGÊNCIA E PROTEÇÃO CIVIL

[Criar CTO](#) [CTO's](#) [Consultar estatísticas](#)

Iniciar Sessão

Email:

Password:

Iniciar Sessão

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SOBRE O SITE

- Mapa do site

AVISOS LEGAIS

- Acesso à Informação
- Proteção de dados

SITES ANEPC

- A Terra Treme
- Aldeia Segura Pessoas Seguras
- InfoRiscos
- SIPE
- SNPCE
- RNBP

eportugal

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Figure 27 – 1st Mockup Login Page

Users will be authenticated via their email and a password.

Depending on the specific roles/permissions of the user, there will be three possible views on the display of the CTO's list, as shown in the next figure.

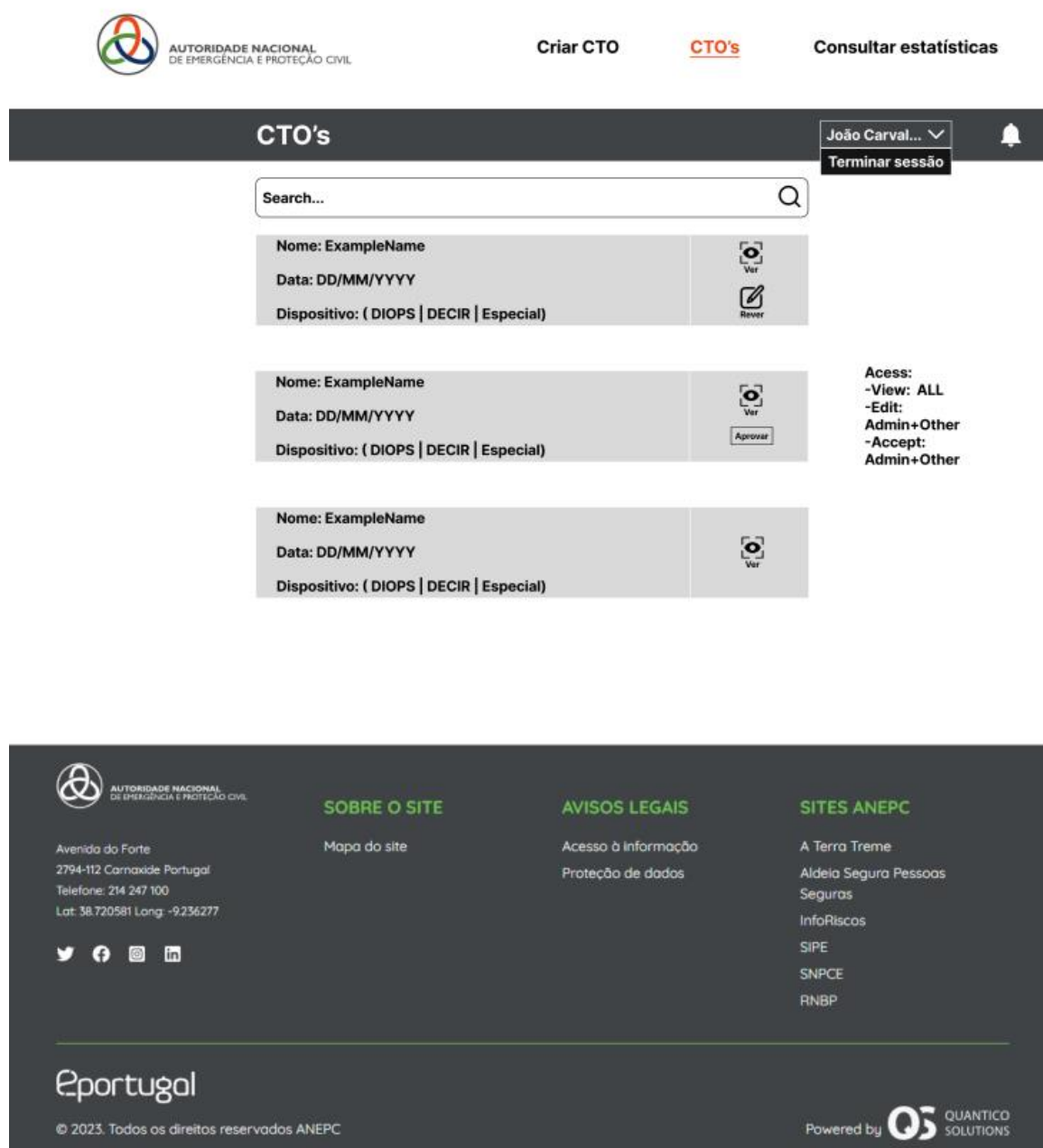


Figure 32 – 1st Mockup CTO's Page

The information inside each of the three grey rectangles is restricted to the specific permissions of the user and the state of the CTO. If a given CTO can be viewed and/or edited, the top box appears. If a CTO has been created and is waiting for approval the second box appears. Finally, a CTO can be visualized, but not edited, if the user lacks editing permission. Of note, the appearance of one or several of the boxes, as well as the editing permission, are restricted to the user's role. Someone without permission to edit, only sees the last box.

At this stage the statistics page was not planned well enough to be shown here.

For a comprehensive view of the current design and features of the prototype, you can explore the mockup provided on Figma using the following link: [\[Mockup on Figma\]](#)

Glossary

LEI	Bachelor in Computing Engineering (<i>Licenciatura em Engenharia Informática</i>)
TFC	Final Course Work (<i>Trabalho Final de Curso</i>)
EPE	State of Special Readiness (<i>Estado de Prontidão Especial</i>)
ANEPC	Portuguese National Authority for Emergency and Civil Protection, (<i>Autoridade Nacional de Emergência e Proteção Civil</i>)
CTO	Technical-Operational Announcements (<i>Comunicado Técnico-Operacional Nacional</i>)
IPMA	Portuguese Institute for the Ocean and Atmosphere (<i>Instituto Português do Mar e da Atmosfera</i>)
GNR	National Republican Guard (<i>Guarda Nacional Republicana</i>)
CMS	Content Management System
ERD	Entity-Relationship Diagram