DADIVA IPO
Digital Aid and Donor Information Verification Application for IPO

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Relatório do projeto realizado no âmbito de Projecto e Seminário
Licenciatura em Engenharia Informática e de Computadores

Junho de 2024

Instituto Superior de Engenharia de Lisboa

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Digital **A**id and **D**onor **I**nformation **V**erification **A**pplication for **IPO**

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Resumo

Texto do resumo. Breve descrição do projeto, dos resultados importantes e das conclusões: o objetivo é dar ao leitor uma visão global do projeto (não deve exceder uma página).

Abstract

The Instituto Português de Oncologia (IPO) in Lisbon currently employs a manual system for managing blood donor information. This involves donors completing a pre-donation form on paper, followed by a medical interview where a doctor assesses eligibility based on the form and additional verbal questions. This manual process of handling and verifying medical and medication details is prone to errors and inefficiency.

The proposed project aims to digitalize the blood donation process at IPO. This includes creating a digital version of the pre-donation form and developing a system to manage and cross-reference medication and pathology data. The digital system will allow for easy updating, customization, and retrieval of information. By automating the form and data handling, the project seeks to reduce errors associated with manual data management and decrease the overall time required for the donation process, thereby streamlining both donor signup and triage procedures.

Contents

Chapter 1

Introduction

Blood donation services play a vital role in the healthcare systems of nations worldwide, serving as a cornerstone of public health initiatives. In Portugal, the establishment of the Blood National Institute (Instituto Nacional do Sangue) in 1958 marked the inception of formal coordination of transfusion medicine. This institution, evolving over more than five decades, culminated in the establishment of the Portuguese Blood and Transplantation Institute (Instituto Português do Sangue e da Transplantação, IPST) in 2012 [1].

Throughout this historical trajectory, blood donation services have undergone substantial organizational reforms aimed at ensuring the safety of both donors and recipients. However, the donor screening process has seen limited evolution despite these systemic changes.

The "Council Recommendation of 29 June 1998 on the suitability of blood and plasma donors and the screening of donated blood in the European Community" underscores the importance of gathering information from potential donors through written questionnaires. Although the specifics of these questionnaires may vary among Member States, their primary objective remains consistent: to identify common risk behaviors and diseases.

According to the 2022 Transfusion Activity and the Portuguese Hemovigilance System Report [2], Portugal recorded 306,796 blood donations from 203,287 donors, with 373,209 donor registrations during the same period. Notably, the main reason for temporary suspension of blood donations is low hemoglobin levels, followed by recent travel to high-risk regions and engagement in behaviors associated with increased health risks.

Institutions like the Portuguese Oncology Institute (Instituto Português de Oncologia, IPO) in Lisbon, which contributed 1.88% of total blood donations in 2022, still rely on traditional, paper-based questionnaires for donor screening. However, this manual process, coupled with the need for cross-referencing against guidelines provided by IPST, is susceptible to inefficiencies and errors. Such inefficiencies may contribute to reduced donor adherence and suboptimal health outcomes.

In partnership with Lisbon's IPO this project endeavors to address these challenges by developing a digital platform. The platform aims to provide donors with a comprehensive digital questionnaire encompassing both standard and relevant sub-questions pertinent to the

screening process. For healthcare professionals, the platform will offer streamlined access to donor responses alongside information regarding potential health risks. Additionally, administrators will have tools to manage user accounts, questionnaire structures, and information regarding drug/disease interactions with blood donation.

By reducing the need for additional questions during screening consultations, this platform seeks to enhance donor participation. This is particularly crucial given the observed decline in donor numbers and donations from 2013 to 2022, amounting to a decrease of over 30,000 donors and 50,000 donations. Through these efforts, we aim to foster greater engagement with blood donation initiatives, thus contributing to the broader health and well-being of our community.

The main challenge with this project is regulatory compliance, particularly given our team's limited expertise in this domain and, to confront this challenge, our development strategy prioritizes the creation of adaptable functionalities designed to meet a broad range of regulatory requirements. Additionally, maintaining close collaboration with Lisbon's IPO will afford us invaluable guidance, ensuring our platform aligns with established frameworks and standards. By taking these proactive measures, we aim to navigate regulatory complexities effectively and develop a robust, compliant solution that can be tailored to the needs of blood donation services.

Chapter 2

Problem Description

Current blood donation workflow faces a set of challenges like screening time for more complex cases can be time consuming, as well as cross checking information about drug and pathology interaction, and printed forms need to be disregarded when legislation or the form's structure is changed.

Screening time can be reduced by employing a dynamic form, in digital format, that shows relevant follow up questions according to the potential donor's answers, thus collecting relevant information, that would otherwise need to be obtained during the medical screening. This solution raises a set of questions such as:

- What data structure is appropriate do describe the form's structure and flow/logic - the questions order, possible answer values, what answers trigger or suppress follow-up questions;

- How will the form's rule be enforced in a way that doesn't mix domain and rules - the front-end should be able to show and compute various forms and a form change shouldn't need to be accompanied by changes to the front-end implementation.

Upon form submission the information supplied by the potential donor, or automatically obtained, can be automatically cross checked against IPST guidelines for drug and pathology interaction with blood donation. This solution raises a set of question such as:

- How are the potential donor's drug and disease information validated - the number of available drugs and possible diseases might be to great for real time validation, when the user is inputting that information into the form;

- Are the IPST guidelines available in a machine readable format that make it feasible to be cross checked against the form's answers - currently the guidelines are available in pdf and printed format, sometimes drugs/pathologies are individually mentioned and sometimes grouped in a family (ie there's no mention of aspirin in the 2022 manual, instead the term Non Steroidal Anti Inflammatory medication is used).

The digital form structure and flow, pathology/drug interaction and terms of service information should be update-able in the back-office. This solution raises a set of question such as:

- How can the form structure and flow be visualized in an intuitive way - the user changing the form shouldn't need to know anything about it's implementation but still be able to identify it's flow;

- How will the drug/pathology interaction be updated - will a user manually insert information in the back-office or are can it be requested from a web-service.

Beyond these specific challenges the platform will have to employ three types of users, donors, that can access the form and submit form responses, doctors, who can view donors form answers and pathology/drug interactions, and administrators, who can manage users, form structures, drug/disease and regulatory compliance interaction information.

2.1 Proposed Solution

In order to solve the challenges listed above, we have developed DADIVA IPO.

DADIVA IPO is a web platform that allows blood donation services to decrease the screening time of blood donation candidates via an update-able dynamic form and automatic interaction verification.

It is intended as an alternative to the current, and less versatile, paper form used by blood donation services in Portugal, such as Lisbon's IPO.

2.1.1 Functional Requirements

- Donors should be able to quickly fill out a digital pre-donation form. The form should be adequate according to the current law, adaptable, and depend on the donor's answers.

- Doctors should be able to find all relevant data on pathology and/or medication interactions with the donation in a digital format.

- Doctors and administrators should be able to access a back office used for customizing the pre-donation form and for updating the pathology and/or medication interaction information. The back office should also allow for user management.

- Google-like search and results by relevance - Search should be as simple as possible. There may be a need to increase the number of filters, but this complexity should be hidden. The results returned should be sorted based on relevance.

2.1.2 Non-Functional Requirements

- Intuitive user experience through a simple and practical user interface.

- Responsive design that ensures a good user experience both on desktop and mobile.

- Complete and thorough documentation.

- Unit and integration testing with sufficient coverage to ensure confidence that the system is working without flaws.

- Good software engineering practices to ensure the fast development of the system.

2.1.3 Optional Features

- After filling out the pre-donation form, the system could automatically check if the donor had any vaccinations and/or prescriptions that could be medically relevant. It would require integration with the SNS, and/or Infarmed systems.

- The medical interview may be based on a pre-analysis, with the system having already identified possible risk vectors and logical incongruencies that better assist the doctor when deciding on accepting or refusing the donor.

- It is possible that the IPST has already implemented a digital system to maintain pathology and medication interaction information. If so, it would be possible to integrate this into our system, so that this information does not have to be manually updated.

- Users can authenticate using the Digital Mobile Key (CMD). It would require integration with the AMA (Administrative Modernization Agency) systems.

2.1.4 Use Cases

With the requirements listed above, we have identified the use cases that the platform shall support. A use case is a written description of how users will perform tasks on a system. It outlines, from the user perspective, the behavior of the system as it responds to a request. The use cases identified shall allow to reason about who are the users of the platform, their objectives, the actions they are able to perform, and how the platform shall respond to each action. The use cases are divided into three categories, each representing one type of user. The Donor use case is presented in Figure 2.1. The donor user can request the current form and can submit their form responses.
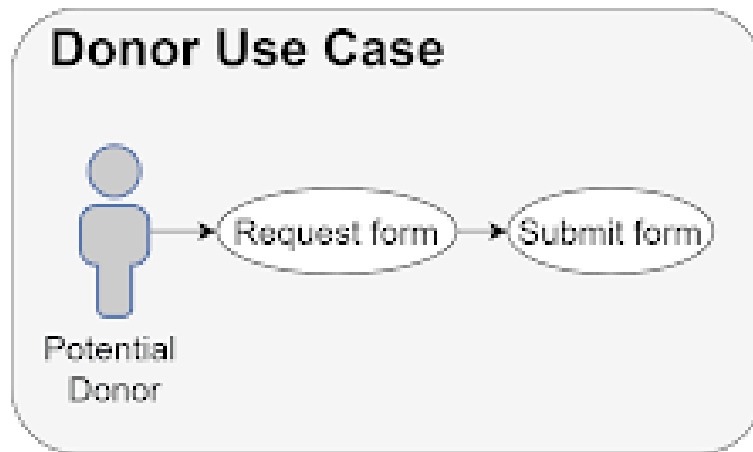
Figure 2.1: Donor use case.

After a donor submits their form responses a doctor user will be able to access their answers by searching by the user's unique id as presented in Figure 2.2.
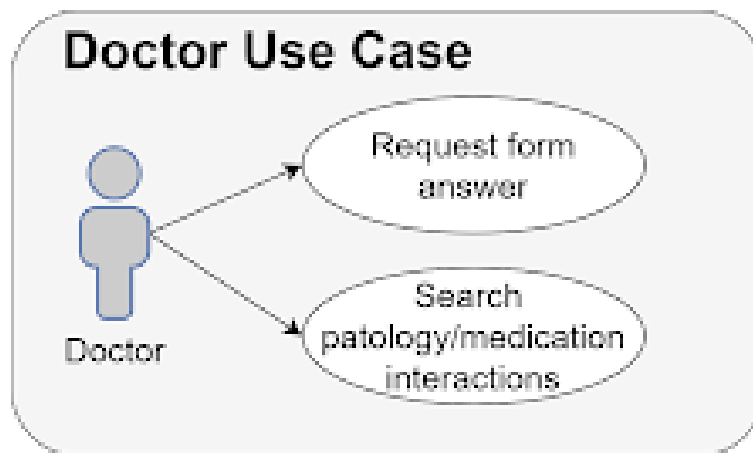

Figure 2.2: Doctor use case.

Furthermore the doctor user is able to search for pathology/medication interactions to resolve any inquiries that might appear during the screening.

Finally the administrator user can update the form structure and flow, update the interaction information and manage the platform's users. The administrator use case is presented in Figure 2.3.
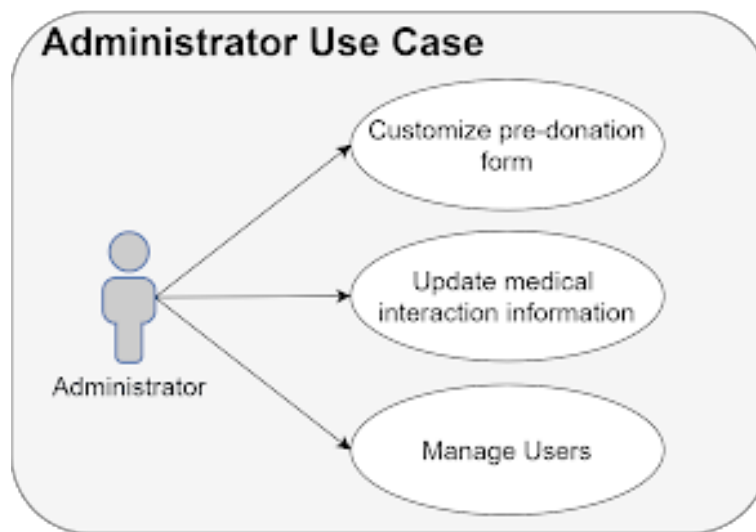
Figure 2.3: Administrator use case.

Chapter 3

Architecture

This chapter provides an overview of the system's components and their interactions. It outlines the capabilities of the project and presents the architecture, entities, and implementation blueprint that have been designed and developed.

3.1 Overview

Figure 3.1 presents a diagram illustrating the main components of the system and their interactions. The system consists of a backend application (server-side) and a frontend application (client-side). The backend comprises a collection of services, responsible for data processing and storage in a ElasticSearch database. The frontend is composed of a web application, that facilitates user interaction. Communication between the frontend and the backend is achieved through a REST API, utilizing the HTTP protocol [24].
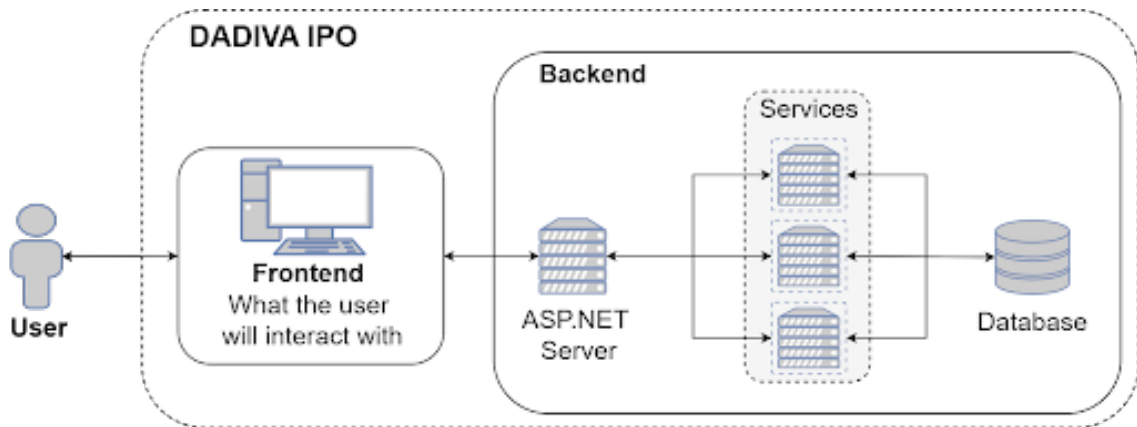

Figure 3.1: Application Architecture.

3.2 Form Data Model

The first approach to solve de dynamic form challenge was to use a data structure formed by main questions and sub-questions, example presented in Figure 3.2, where a main question

can only be answered with boolean values, and one of those values triggers the display of a sub-question which has a certain type of response, such as boolean, dropdown for known multiple answers, which needed an extra field, response range, to specify possible values, and text to accept user text input.

```
form:{
    question: "Have you traveled outside of Portugal?",
    subQuestion:{
        rule: "yes",
        question: "To which continent?",
        responseType: "dropdown",
        responseRange: ["Africa", "Europe", "Asia", "Oceania", "North America", "Central
America", "South America"]
    }
    .
    .
    .
    question: "Are you taking any medication?",
    subQuestion:{
        rule: "yes",
        question: "Which one?",
        responseType: "text"
    }
}
```

Figure 3.2: First Form Data Structure.

This approach has some drawbacks, such as the fact that it disables the possibility of supressing further questions hence not adhering to the principle of creating an adaptable solution, and mixes questions and rules in the sub-question.

Upon further discussion we settled on using a more complex data structure , exemplified in Figure 3.3, composed by a list of questions and a list of rules.

Each question has an id, the text that composes it and the type of responses.

Each rule has a condition, which can be "any","all","not" and when any, all or none of the conditions are met an event is triggered, which can be to show os hide a question, the question's id that's being targeted by the event is supplied via the params field.

```
form:{
   questions: [
      {
      "id": "0",
      "text": "Have you traveled outside of Portugal?",
      "type": "boolean"
   },
   {
      "id": "1",
      "text": "To which continent?",
      "type": "dropdown"
   }
   ]
   "rules": [
      {
         "conditions": {
            "any": []
         },
         "event": {
            "type": "showQuestion",
            "params": {
               "id": "0"
            }
         }
      }
   ]
}
```

Figure 3.3: Final Form Data Structure.

Chapter 4

Exemplos

A nossa solução é apresentada neste capítulo. A solução consiste em grandes ideias, desenvolvidas e testadas.

Exemplo de indentação do segundo parágrafo.

4.1   Nome da primeira secção deste capítulo

Texto da secção. Seguem-se exemplos de vários parágrafos.

Esta unidade curricular funciona no semestre de Verão de cada ano letivo. Nos casos de impedimento prolongado justificado (designadamente por doença ou por motivos profissionais no caso dos trabalhadores-estudantes), poderá ser prolongada, havendo lugar à elaboração de outro relatório de progresso e a nova inscrição se o prolongamento for além do período de época especial desse semestre. A entrega da justificação e a sua apreciação deverão ocorrer antes do final do prazo estabelecido para a entrega final.

O estudante só poderá frequentar Projecto e Seminário se, em conjunto com as restantes unidades curriculares em que se inscreve nesse semestre isso corresponder, no máximo, a 44 créditos ECTS, tendo acumulado, pelo menos, 138 créditos. No caso de estudantes em regime de tempo parcial, o valor máximo está limitado a 30 créditos no ano letivo. Não são admitidas inscrições como unidade curricular isolada.

Anualmente é divulgada a lista de ideias para projetos e respetivos orientadores. Os estudantes poderão propor outras ideias identificando os orientadores. A escolha da ideia de projeto é feita no período de interrupção letiva após o semestre de Inverno. As propostas de projeto são registadas no início do período letivo do semestre de Verão, verificado que os estudantes reúnem as condições de frequência. O projeto deve ser realizado em grupo de dois estudantes (excecionalmente um ou três). Cada elemento do grupo tem tarefas específicas pelas quais é responsável. Esta situação deve ficar clara desde o início do projeto.

A orientação dos projetos é feita por docentes da área departamental onde o curso está ancorado ou por especialistas externos, podendo haver coorientadores, mas sendo obrigatória a coorientação por docente da área departamental no caso de orientação externa. O desenvolvi-

mento do projeto é acompanhado de reuniões periódicas do orientador (ou coorientadores) com o grupo. A informação referente ao projeto é mantida em formato eletrónico em local acessível pelos elementos do grupo, pelos orientadores e pelos docentes de Projecto e Seminário.

A avaliação de Projecto e Seminário envolve:

1. proposta do projeto;

2. relatório de progresso;

3. apresentação individual;

4. cartaz e versão beta do projeto;

5. relatório de projeto e discussão pública final.

A avaliação incide sobre o trabalho planeado e desenvolvido pelos estudantes, com constrições de tempo e prazos previamente estabelecidos. Se durante a realização do projeto for considerado que este está em risco, ouvidos os estudantes envolvidos, o orientador e o docente da unidade curricular decidem se o projeto continua. Em caso de desistência do estudante, esta deve ser comunicada ao orientador do projeto e ao regente da unidade curricular.

4.2 A segunda secção deste capítulo

Na segunda secção deste capítulo, vamos abordar o enquadramento, o contexto e as funcionalidades.

4.2.1 A primeira sub-secção desta secção

As sub-secções são úteis para mostrar determinados conteúdos de forma organizada. Contudo, o seu uso excessivo dificulta a leitura do documento.

4.2.2 A segunda sub-secção desta secção

Esta é a segunda sub-secção desta secção, a qual termina aqui.

4.3 Descrição detalhada da solução

A solução proposta assenta nas seguintes ideias. O algoritmo 1 apresenta as ações de pesquisa de um elemento E sobre um grafo G.

Algoritmo 1 Algoritmo de pesquisa em grafo.

Dados: Grafo G, Elemento E

Resultado: Localização de E em G

1. Para todos os vértices v em G

2. Pesquisar e obter a localização de E

   (a) Iniciar a lista de pontos, P

   (b) Ordenar P

Nalgumas situações, é necessário apresentar excertos de código que ilustrem aspetos relevantes da implementação.

```
namespace ps;
public static void main() {
  System.out.println(``PS - Projecto e Seminário'');
}
```

Chapter 5

Testes

Este é o capítulo de testes. É possível forçar a inclusão de todas as referências com [].

Modo de matemática em texto $x = ma^2$ e em equação (duas formas):

$$x = ma^2$$

$$x = ma^2 \tag{5.1}$$

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Appendix A

Exemplo de apêndice

Este é o primeiro parágrafo do apêndice.

Etiam ac leo a risus tristique nonummy. Donec dignissim tincidunt nulla. Vestibulum rhoncus molestie odio. Sed lobortis, justo et pretium lobortis, mauris turpis condimentum augue, nec ultricies nibh arcu pretium enim. Nunc purus neque, placerat id, imperdiet sed, pellentesque nec, nisl. Vestibulum imperdiet neque non sem accumsan laoreet. In hac habitasse platea dictumst. Etiam condimentum facilisis libero. Suspendisse in elit quis nisl aliquam dapibus. Pellentesque auctor sapien. Sed egestas sapien nec lectus. Pellentesque vel dui vel neque bibendum viverra. Aliquam porttitor nisl nec pede. Proin mattis libero vel turpis. Donec rutrum mauris et libero. Proin euismod porta felis. Nam lobortis, metus quis elementum commodo, nunc lectus elementum mauris, eget vulputate ligula tellus eu neque. Vivamus eu dolor.

Nulla in ipsum. Praesent eros nulla, congue vitae, euismod ut, commodo a, wisi. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Aenean nonummy magna non leo. Sed felis erat, ullamcorper in, dictum non, ultricies ut, lectus. Proin vel arcu a odio lobortis euismod. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Proin ut est. Aliquam odio. Pellentesque massa turpis, cursus eu, euismod nec, tempor congue, nulla. Duis viverra gravida mauris. Cras tincidunt. Curabitur eros ligula, varius ut, pulvinar in, cursus faucibus, augue.

Nulla mattis luctus nulla. Duis commodo velit at leo. Aliquam vulputate magna et leo. Nam vestibulum ullamcorper leo. Vestibulum condimentum rutrum mauris. Donec id mauris. Morbi molestie justo et pede. Vivamus eget turpis sed nisl cursus tempor. Curabitur mollis sapien condimentum nunc. In wisi nisl, malesuada at, dignissim sit amet, lobortis in, odio. Aenean consequat arcu a ante. Pellentesque porta elit sit amet orci. Etiam at turpis nec elit ultricies imperdiet. Nulla facilisi. In hac habitasse platea dictumst. Suspendisse viverra aliquam risus. Nullam pede justo, molestie nonummy, scelerisque eu, facilisis vel, arcu.