School of Electronic Engineering
and Computer Science

Final Report

Programme of study:
BSc Computer Science

Project Title:

**Automation of the
Royal College of Radiology's
Job Plan and AAC Processes**

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I would like to thank the following:

Abstract

This project is to automate the long admistratration project of advertising job posts for consultant doctors, and then setting up interview panels for them. tbc

Contents

1 Introduction

1.1 Background

The Royal College of Radiologists (RCR) plays a pivotal role in ensuring high standards in the recruitment process within radiology and oncology. Of particular importance is the quality assurance provided by Job Description (JD) review and Advisory Appointment Committee (AAC) panels. The RCR states that its processes ensure "candidates have clarity and confidence in applications, recruiting organisations attract and retain the best possible appointee, and vacancies are filled efficiently, benefitting existing consultant staff." (www.rcr.ac.uk, n.d.).

The National Health Service (NHS) understands the complexity of this process, and states that "The administrative burden associated with job planning is considerable. Success depends on having systems in place and information available", and Trusts are highly recommended to invest in electronic job planning software (Consultant job planning: a best practice guide, 2017).

This is of particular importance, given the concerning shortfall in clinical radiology and oncology. With shortfalls of 17% in oncology and 29% in radiology, safe and effective care is limited. Moreover, these shortfalls are expected to worsen in the future. Doctors have had their pay cut, and 83% report some form of burnout (www.rcr.ac.uk, n.d.). This has profound implications for patient care and service delivery. Shortages lead to longer wait times for diagnoses and treatments, potentially worsening patient outcomes, in fact every month of delayed cancer treatment increases patients' risk of death by 10% (Limb, 2022). By 2029, these professions will need to grow by 45 percent (Strategic Framework for Cancer Workforce 05-07, 2018).

Annual job plans, as defined by the RCR, are agreements between doctors and their employers "setting out the duties, responsibilities and objectives of the doctor" (Clinical radiology job planning guidance for consultant and SAS doctors 2022, 2022). This process, which involves completing review forms in Microsoft Word and subsequent email communication, often leads to back-and-forth discussions between the NHS Trust, RCR, and Regional Speciality Advisor (RSA). Every detail, including every date an email is sent or received, is meticulously recorded in a large Excel spreadsheet. This process ensures that job plans are fair and realistic.

On the other hand, the AAC process is "a legally constituted interview panel established by an employing body when appointing consultants." (www.rcseng.ac.uk, n.d.). Representatives are mandated by the NHS to ensure that the panel constitutes a balanced Committee (The National Health Service (Appointment of Consultants) Regulations Good Practice Guidance, 2005). This process, involving the handling of sensitive data such as doctors' emails and phone numbers, requires encryption and password protection. Trusts often require multiple lists to find an available representative, as these individuals, being consultant doctors themselves, typically have busy schedules. The RCR's involvement ensures that the selection process adheres to high professional standards and that candidates are evaluated fairly and competently.

Their process is deliberately extensive for good reason. Generic healthcare recruitment software does not address the specialised, nuanced steps that are required by the RCR. Many aspects are legal requirements by the NHS that must be followed by every non-foundation Trust and Royal College (www.rcseng.ac.uk, n.d.). Automation would allow for the streamlining of these operations, significantly reducing the administrative burden

and likelihood of manual errors. Offering a more reliable and consistent approach to managing the recruitment process is a necessity to cope with the increasing demands of healthcare delivery, and to support the overburdened workforce.

1.2   Problem Statement

Despite its critical role in maintaining employment standards, the RCR's current system faces significant inefficiencies and limitations. Managed primarily through manual operations involving Excel, Outlook, and Word, the risk of errors is high, contributing to an already time-consuming and labour-intensive process. These stand-alone applications have limited integration capabilities, requiring manual data transfer, and making automation of repetitive tasks extremely difficult, unreliable, or downright impossible. Although Excel is powerful for data manipulation, it is ill-suited for tracking complex workflows. It lacks the ability to monitor process stages, complex data integrity mechanisms, concurrency and multi-user environments, and handling of large datasets. Consequently, the RCR is forced to create a new spreadsheet annually, increasing time wasted searching through multiple different files. The lack of data normalisation and continuity makes it difficult to track and analyse specialities, which is essential for reporting.

Data analysis is critical for improving efficiency. The RCR states that Advisory Appointment Committee (AAC) data is collected to "check that the appointee is qualified to train doctors for the future, track increasing or decreasing numbers of doctors, track increases or decreases in different types of posts, track where it may be difficult for NHS Trusts to attract new recruits" (www.rcr.ac.uk, n.d.). Without these metrics it becomes difficult to provide guidance on how to allocate resources correctly, which is essential for resolving consultant shortages.

Delays and errors, inherent in manual systems, can cause Trusts to miss critical deadlines for filling vacancies and to lose out on high-quality candidates. This must be avoided at all costs, as the NHS Appointment of Consultants Regulations state that "Only in extreme circumstances should it be necessary to cancel an AAC." (The National Health Service (Appointment of Consultants) Regulations Good Practice Guidance, 2005). Significant staff time, which could be better utilised in more critical roles, is dedicated to this tedious and manual process. This issue affects not only the RCR, but also Trusts' teams, Regional Speciality Advisors (RSAs) reviewing Job Plans, RCR representatives assessing panels, and the candidates who are pivotal in delivering lifesaving patient care.

1.3   Aim

This project aims to develop an automated system specifically tailored for the Royal College of Radiology (RCR), to manage and accelerate their Job Plan and Advisory Appointment Committee processes. Integrating an SQL database will ensure that a more robust system cooperates with an automated workflow, works with large datasets and complex data relationships, and ensures data integrity and security. This integration will give the RCR the ability to analyse the data for reporting using tools such as PowerBI. Routine tasks are best automated with suitable web development frameworks such as SvelteKit and Django. Implementing data security and compliance with encryption software like OpenSSL, password protection, and secure data storage solutions will allow the project to comply with GDPR and NHS regulations. By creating a user-friendly, customised, and accessible interface, we can simplify the process for all stakeholders.

2 Literature Review

2.1 Recruitment Process

2.1.1 Job Descriptions
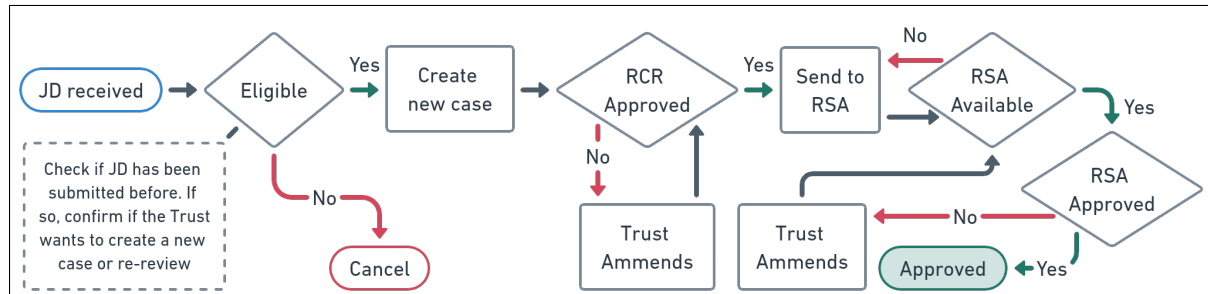
The Job Description (JD) process presented above reflects the meticulous approach followed by the Royal College of Radiologists (RCR) to ensure quality and precision. The process begins with the receipt of a job description, which is then subjected to preliminary checks. If the JD meets the initial criteria, it moves forward to a more detailed examination by a Regional Specialty Advisor (RSA). If the RSA is unavailable at any stage, a new RSA is promptly assigned. The diagram shows multiple checkpoints and potential loops that can occur if information is missing or incomplete, yet every effort must be made to complete this entire process within 2 weeks. The process concludes by informing the Trust that they are permitted to advertise their post and by sending them a form to complete to request a list of representatives.

2.1.2 Advisory Appointment Committees
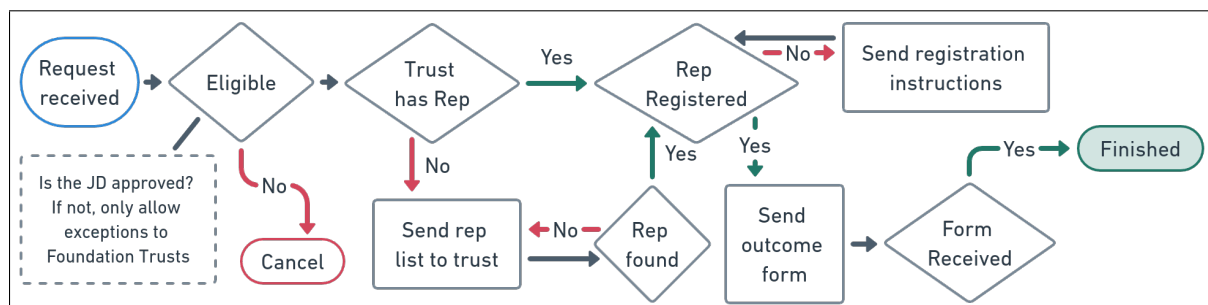
The Advisory Appointment Committee (AAC) process, as illustrated above, is equally rigorous and focuses on giving Trusts the best chance of securing a representative. This process begins by checking whether the previous Job Description (JD) process was successful, only granting exceptions when requested by a Foundation Trust. Like the JD process, it often involves loops when sending multiple lists to the Trust. If the Trust opts to source their own representative, either upon request or after an unsuccessful search, the appropriate guidance and rules must be sent. All representatives must complete training and registration to attend panels. The process concludes when the representative returns an outcome form sent to them to complete after the panel is held, or if the Trust cancels the panel for any reason.

2.2 Related Works

2.2.1 Existing Storage System

With Excel, the primary limitation is the lack of ability to store speciality data. This is because job posts often have multiple primary specialities and secondary sub-specialities. If opting for a single column, data integrity becomes almost impossible as Excel does not inherently support complex data validation for multiple entries within a single cell. This makes it difficult to ensure that the data entered is consistent and makes analysing and querying this data challenging. Using multiple columns for each specialisation provides a more structured way to store this data. However, in this context it quickly becomes unwieldy – in our case we are left with 44 columns. Here the spreadsheet becomes cluttered and difficult to navigate.

The same issues apply to tracking the date of each step of the process, as due to loops in the workflow we often encounter multiple dates in each cell. With no automation whatsoever, these dates, as well as the workflow's status, must be entered manually every time.

The core issue with both approaches is the lack of normalisation. By splitting data into multiple related tables, and establishing relationships between them, we can reduce redundancy and improve data integrity. This is only realistic if we use a relational database management system like SQL.

2.2.2 Healthcare Recruitment Tools

Searching for software to assist with recruitment in the healthcare sector will bring up results such as ICIMS and The Access Group. Unfortunately, these programs are typically directed towards the Trust rather than Royal Colleges. Their intended user base is employers looking to advertise and interview candidates, not for those involved in the rigorous job plan review and representative selection process required by the Royal College of Radiology (RCR). These solutions typically require private meetings, so understanding their capabilities is difficult. For a set of requirements this specific, only personalised software is suitable.

2.2.3 Other Royal Colleges

Finding specific details on the software used by other Royal Colleges in the UK is not possible as this information is not typically disclosed publicly. Though the general process for Advisory Appointment Committees (AAC's) is somewhat standardised across various Royal Colleges due to the strict requirements set out by the NHS, there is no central piece of software. The advantages to an open-source solution may span beyond just the Royal College of Radiology (RCR).

While the overall process is shared, there are still many differences between colleges. Each email and form would differ, and doctors in various departments have distinct needs. A software flexible enough to accommodate everyone is far beyond the scope of this project. For example, the Royal College of Physicians (RCP) requires that medical staffing departments complete the job description review form themselves, in contrast to the RCR filling it out for them. This may, however, be an indication that this project should accommodate any policy changes that the RCR may implement. The RCP also requires foundation Trusts to submit representative requests with a minimum of eight

weeks' notice, a guideline that is optional but recommended in many other colleges, and offers an optional kitemark (RCP London, 2017).

With differing requirements, it's no wonder that simply sharing software with each other is not a solution. A project that would suit every Royal College would be an expensive undertaking.

3   Design
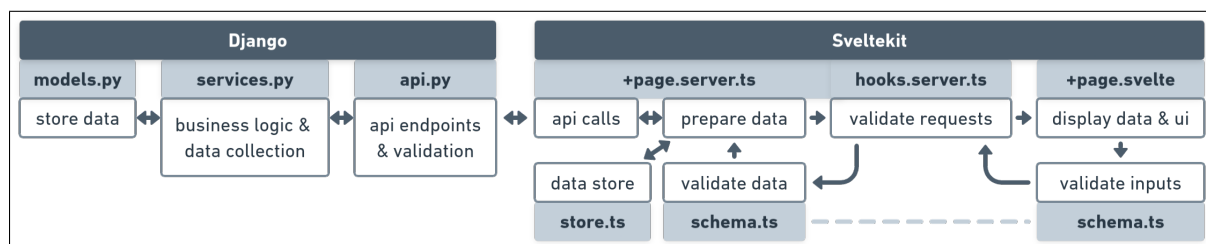
The following paragraphs will be edited to explain their advantages specifically for this project - rather than just being a general description.

Good design follows C.R.A.P principles. It is Consistent, it is Readable, it is Accessible, and it is Predictable. (SOURCE) This is a idea by a german ... for example in our design...

We can also take ideas from Normans and the three paradigms of HCI (source source)

The choice of background color in this project (dark and gray and light more) (source). The dotted background in lightmode gives users a .... easier on the eyes ... dark mode for those working late (which is common) ...

This project uses the Noord font (source), a relatively unknown but very modern and clean... sans-serif because ...

Shadcn-Svelte, a library for SvelteKit (see 3.2), created by Huntabyte, makes designing the User Interface easy. It also depends on a collection of Svelte-based tools and libraries aimed at enhancing web development workflows. This includes zod, and formsnap (which relies on superforms), which allows validation to be done on the client side. This allows for a responsive user experience which...

Shadows give a ...

The purple color is chosen because the RCR... Red for the logout button (source)

3.1   Backend

Django is a high-level Python web framework that enables rapid development of secure and maintainable websites. It takes care of much of the hassle of web development, so you can focus on writing your app without needing to reinvent the wheel. It follows the "battery-included" philosophy and provides a robust set of features to build web applications. It emphasises reusability and "pluggability" of components, less code, low coupling, rapid development, and the principle of don't repeat yourself (DRY). (SOURCE)

It is preferred over XYZ because...

Django-Ninja is a web framework for building APIs with Django and Pydantic. It is designed to be fast, easy to use, and type-safe. Django-Ninja leverages the Pydantic library for data validation and settings management using Python type annotations. This integration ensures that API requests and responses are type-checked, leading to cleaner and more maintainable code. It aims to provide a more intuitive and productive way to

build Django APIs, with automatic OpenAPI documentation generation and much faster performance. (SOURCE)

It is preferred over Django Rest Framework because....

Django-Ninja-JWT is an extension for Django-Ninja, through Django-Ninja-Extra, that provides JSON Web Token (JWT) authentication for APIs. It allows for secure and scalable user authentication using JWTs. This tool integrates seamlessly with the Django-Ninja framework, enabling developers to easily add token-based authentication to their API endpoints. (SOURCE) It will be stored in a http only, same site strict cookie to ensure security.

CSRF token handling within django is not required, as the Django backend will not be connected to the internet at all, and SvelteKit handles anti CSRF protection by default. (SOURCE)

3.2 Frontend

SvelteKit is a framework for building web applications using Svelte, a modern JavaScript compiler that produces highly efficient code. SvelteKit provides a seamless development experience by offering server-side rendering, static site generation, and single-page application modes out of the box. It is designed to be flexible and modular, allowing developers to structure their applications as they see fit, while providing a rich set of tools and features to enhance productivity and performance. (Source)

It is preferred over React and Vue3 because...

TypeScript is an open-source programming language developed and maintained by Microsoft. It is a strict syntactical superset of JavaScript, adding optional static typing to the language. TypeScript is designed for the development of large applications and trans compiles to JavaScript. It can catch errors and bugs at compile time, providing a more robust and maintainable codebase. (Source)

Axios is a promise-based javascript library, which provides a more streamlined and readable syntax than Fetch for handling asynchronous operations. It will be used by django to perform CRUD operations. It features a wide array of configurations and supports features such as intercepting requests and responses, cancelling requests, and automatic transformation of request and response data. (Source)

openAPI-typescript allows us to import the django-ninja openAPI schema into the frontend, providing type safety and autocompletion. This ensures that the frontend and backend are always in sync, reducing the likelihood of errors and inconsistencies. (Source)

Postmark is an email delivery service that provides fast and reliable transactional email sending. Its simple yet robust API will allow easy email verification and notifications directly from SvelteKit. It is preferred over self-hosted emailing as those are usually blocked as spam by all major email services. (source)

3.3 Deployment

The project is depoloyed on an ubuntu server with nginx, gunicorn, and node (Elaborate on the reasons) sveltekit has adaptors to ... (sources)

3.4 Requirements

This is the state machine diagram for the system to use for JDs. It is used in the UI to show the user what stage the JD is at, and updates automatically on button press when an update is made.
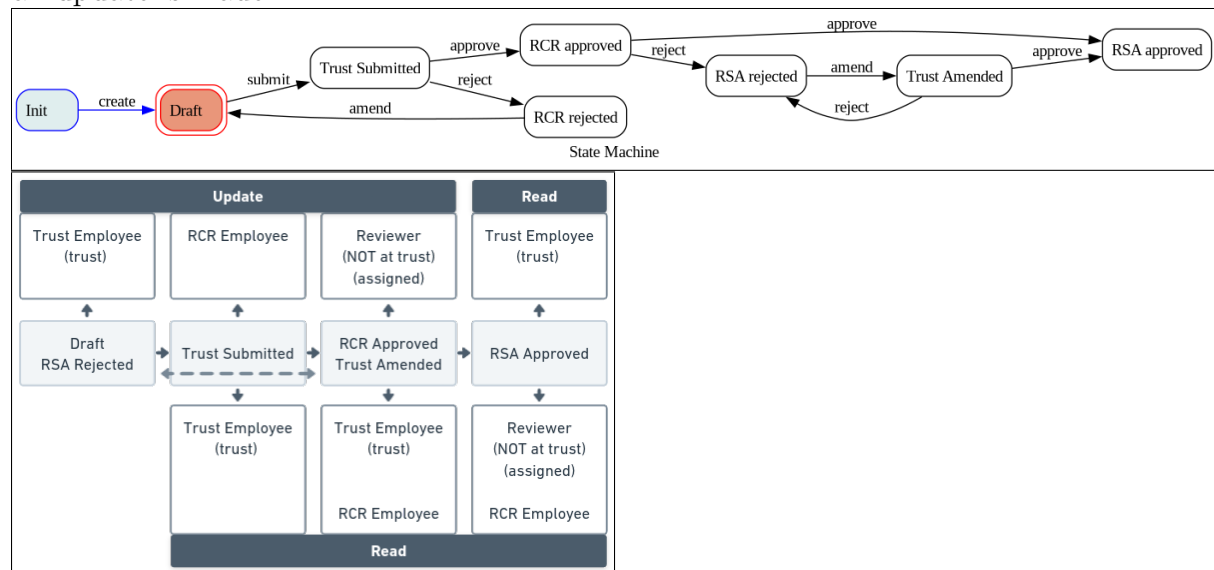
4 Implementation

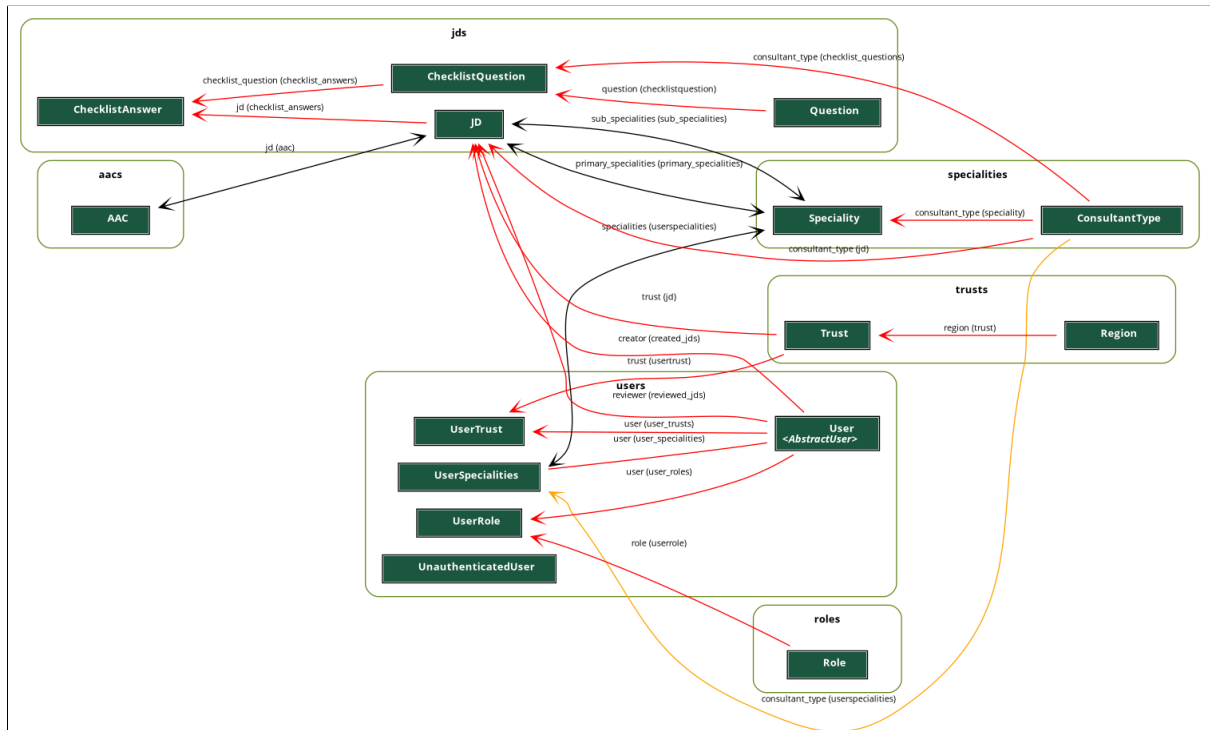## 4.1 Django

4.1.1 Database

Figure x represents the database used. Due to the number of models, fields have been omitted in this version to maintain readability. See figure x in appendix x for a full version.

4.1.2 Schemas

pydantic

4.1.3 Services

django

4.1.4 API Endpoints

django-ninja & django-ninja-jwt

4.2 SvelteKit

4.2.1 Design

The front page greets you with a dark/light mode and a background with dots and a login auth page with

It is perfectly reactive and works on all devices and zoom levels. This is essential to accessibilty, and to allow doctors and trusts to make changes on the go.

By adding shadows to the main content we want the user to focus on, we can accelerate the rate at which they can learn the system. Components with no shadows are used for information that isn't as relvant, but may still be useful on occasions.

4.2.2 API Consumption

4.2.3 Authentication

Good security is essential in this process, as any bad actors could access sensitive information such as personal details, as well as cause havoc on the system. There is potential for one person to delay the radiology and oncology in the uk. Therefore

We do not need CSRF tokens as ...

As seen in Figure x, all routes past the protected/ route go through the hook (which is), which checks if the user is authenticated. If they are not, they are redirected to the login page. This is done by checking the session cookie, which is set when the user logs in. This is a secure way of checking if the user is authenticated, as the session cookie is encrypted and cannot be tampered with. JWT.
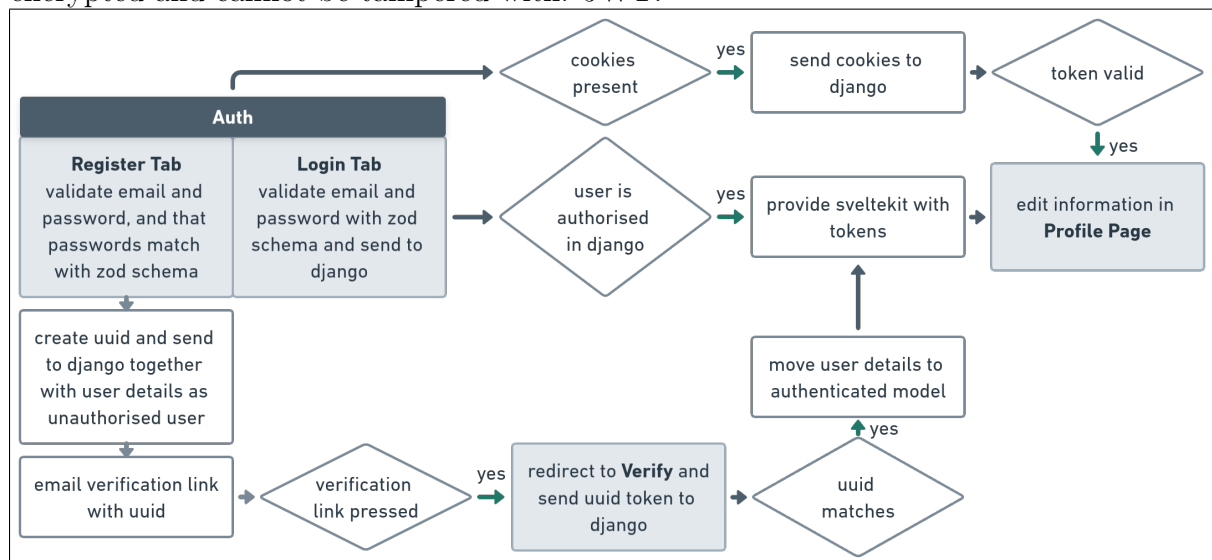
4.2.4 Profile

4.2.5 Panel

This page is incomplete. This is where the list of JDs and AACs will be displayed.

5 Testing

django tests.py
UAT

6 Discussion

7 Further Work

8 Bibliography

This bibliography will be drastically overhauled in the future. It is only included to give credit to the sources used in this draft.

Clinical radiology job planning guidance for consultant and SAS doctors 2022. (2022). Available at: https://www.rcr.ac.uk/media/gzxjd252/rcr−publications_clinical−radiology−job−planning−guidance−for−consultant−and−sas−doctors_october−2022.pdf [Accessed 26 Nov. 2023].

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www.rcr.ac.uk. (n.d.). Advisory Appointment Committee FAQs | The Royal College of Radiologists. [online] Available at: https://www.rcr.ac.uk/our−services/management−service−delivery/advisory−appointment−committee−aac/advisory−appointment−committee−faqs/ [Accessed 26 Nov. 2023].

www.rcr.ac.uk. (n.d.). RCR statement on industrial action | The Royal College of Radiologists. [online] Available at: https://www.rcr.ac.uk/news−policy/latest−updates/rcr−statement−on−industrial−action/#:˜:text=There%20is%20currently%20a%2017 [Accessed 26 Nov. 2023].

www.rcseng.ac.uk (n.d.). Advisory Appointment Committees (AACs). [online] Royal College of Surgeons. Available at: https://www.rcseng.ac.uk/standards-and-research/support-for-surgeons-and-services/aacs/#:~:text=An%20Advisory%20Appointments%20Committee%20(AAC [Accessed 26 Nov. 2023].

9 Appendices

9.1 Database
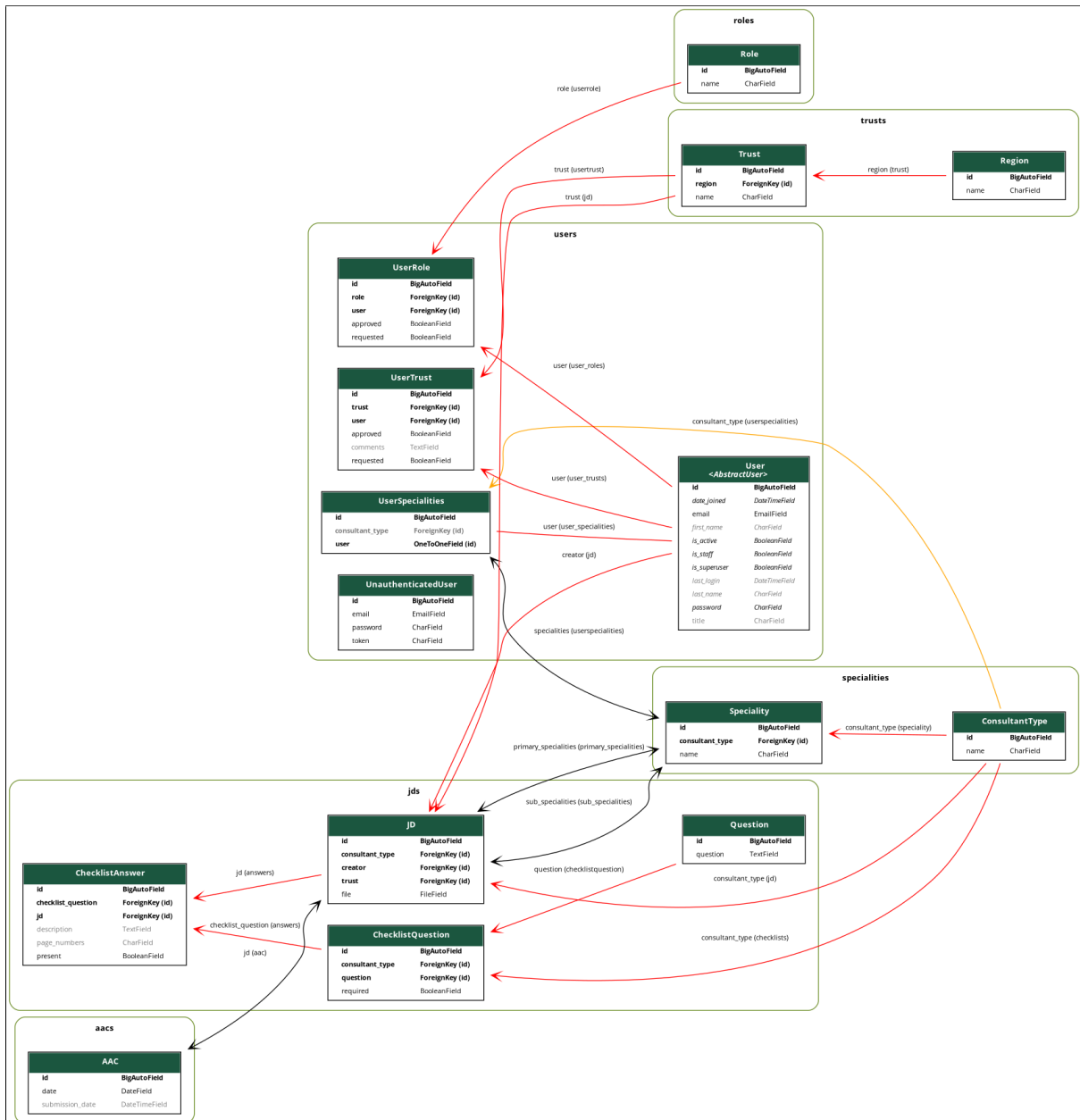
9.2 API Endpoints

Authorize 🔓

token ⌃

POST	/api/token/pair Obtain Token	⌄
POST	/api/token/refresh Refresh Token	⌄
POST	/api/token/verify Verify Token	⌄

users ⌃

POST	/api/users/register-unauthenticated Register Unauthenticated	⌄
POST	/api/users/register-authenticate Register Authenticate	⌄
GET	/api/users/profile/ Get Profile	🔒⌄
PUT	/api/users/profile/ Update Profile	🔒⌄
GET	/api/users/roles/ Get Roles	🔒⌄
GET	/api/users/trust Get Trust	🔒⌄

roles ⌃

| GET | /api/roles/roles/ Get Roles | ⌄ |

trusts ⌃

| GET | /api/trusts/trusts/ Get Trusts | ⌄ |

specialities ⌃

| GET | /api/specialities/specialities/ Get Specialities | ⌄ |

jds ⌃

POST	/api/jds/jd/ Create Jd	🔒⌄
PUT	/api/jds/{jd_id}/ Update Jd	🔒⌄
GET	/api/jds/{jd_id}/ Get Jd	🔒⌄
GET	/api/jds/panel Get Jd Panel	🔒⌄
GET	/api/jds/ids Get Jd Ids	🔒⌄
GET	/api/jds/{jd_id}/checklist/ Get Jd Checklist	🔒⌄
PUT	/api/jds/{jd_id}/checklist/ Update Jd Checklist	🔒⌄
PUT	/api/jds/{jd_id}/submit/ Submit Jd	🔒⌄