AVE Trends in Intelligent Computing Research

An Intelligent NLP-Based Web Application for Automated CV Customisation and ATS Optimisation

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Abstract: This paper describes the creation of a smart web-based app that uses Natural Language Processing (NLP) and Machine Learning (ML) to automate the process of customising CVs. Users can create and manage a central profile in the system that includes their qualifications, work history, skills, and accomplishments. When it receives a job description, the application uses text analysis to identify key requirements and keywords. Then, these parts are compared with the user's profile to create a CV tailored to the job and meeting the employer's needs. The system improves job applications by ensuring they work with Applicant Tracking Systems (ATS) through improved keyword density, document structure, and formatting standards. This method greatly increases the chances that CVs will pass automated screening processes. The suggested fix aims to make it easier and faster to edit CVs by hand while also improving the accuracy and usefulness of the content. The app also supports many output formats, such as Word and PDF, and lets users customise things in real time with little effort. Experimental testing shows that the system is effective at producing high-quality, personalised CVs. This makes it a useful and scalable tool for job seekers in today's competitive hiring climate.

Keywords: Machine Learning; Deep Learning; Transformer Models; Text Summarisation; Abstractive Summarisation; Customer Reviews; Bert and Pegasus; Sentiment Analysis; Data Set.

Cite as: S. Bilal, "An Intelligent NLP-Based Web Application for Automated CV Customisation and ATS Optimisation," *AVE Trends in Intelligent Computing Research*, vol. 1, no. 1, pp. 65–90, 2026.

Journal Homepage: https://avepubs.com/user/journals/details/ATICR

Received on: 10/08/2025, **Revised on:** 29/09/2025, **Accepted on:** 16/10/2025, **Published on:** 05/03/2026

DOI: https://doi.org/10.64091/ATICR.2026.000310

1. Introduction

In the modern, competitive job market, customising CVs for specific job applications has been a time- and effort-intensive process for job seekers. Another complication to this process is the growing use of Applicant Tracking Systems (ATS) by employers [1]. ATS technologies automatically filter and rank CVs based on their similarity to the keywords and criteria defined in a job description. Therefore, prospective applicants must tailor their resumes numerous times to meet the language and formatting requirements of a particular job advert [2]. Not only is this manual customisation time-consuming and labour-intensive, but it also introduces the possibility of human error, which may result in the omission of the most important information or the inability to match the exact wording that the ATS algorithms are coded to search for [3]. Moreover, when job seekers submit applications for multiple vacancies, the need to constantly edit and adjust their CVs makes them less efficient and more prone to errors or omissions. This leaves the applicants in a dilemma: How to be accurate and professional while

effectively customising their CVs to pass through ATS filters. In addition, standard CV builder solutions offer attractive templates to users, but do not allow users to customise the content to meet ATS requirements or dynamically respond to the job description [4]. These tools are often based on general templates and help users develop a properly structured CV more easily; however, they do not help them customise the content or ensure the CV meets the expectations of both ATS and recruiters [5]. This mismatch between the capabilities available to job applicants and those required results in waste and inefficiency, thereby reducing the effectiveness of job applicants in getting a job interview [6].

1.1. Research Question

How can an automated system be built to save the time and effort of customising CVs per job application and yet remain accurate, relevant and compatible with ATS? This is the question under investigation: to develop a system that can rationally automate the process of CV customisation and, at the same time, produce results that meet the high demands of ATS systems. The proposed paper will help resolve the problem of manual CV adjustments, which can take a lot of time and be inefficient, and, as a result, may cause mistakes, by providing an efficient and effective solution. The objective is to develop an automated system that can identify the main job requirements from a job description, compare them with the candidate's profile, and generate a CV that is not only relevant to the job but also in the ATS format.

1.2. Objective

This paper aims to develop an intelligent web-based application that automates the CV customisation process using Natural Language Processing (NLP) and Machine Learning (ML). The system will enable users to have a centralised profile containing their education, work experience, skills, and certifications. Given a job description, the system gets to use the NLP techniques to scan the text, upon which the most relevant keywords and requirements are extracted, and ultimately, these are compared with the user profile to produce a tailored CV. This CV will be job-specific, listing the most relevant skills, qualifications, and experiences, and will ensure the document is formatted according to ATS requirements (keyword density, layout, structure) [2]. The system will also be designed to minimise the time and effort applicants spend preparing their CVs, whilst ensuring the document is highly accurate and relevant to the job in question. To realise this goal, several elements will be incorporated into the system, including a user profile database, a job parsing module, a matching algorithm, and a document generation engine. The system will be compatible with multiple CV formats, i.e., Word and PDF, and can also be customised in real time with minimal user interference. This paper will offer job seekers a smart tool that makes their job application process more efficient, increases their likelihood of passing ATS filters, and ultimately gets them a job interview.

1.3. Justification

The proposed paper can fill an indisputable gap in the existing recruitment process by providing a solution to the boring and ineffective manual CV customisation. Since an increasing number of employers prefer ATS to simplify the process of recruitment, job applicants must ensure that their CVs are compatible with these systems. The customary method of manually searching and customising individual CVs to fit the job description, however, is cumbersome and prone to mistakes. Applicants usually find it hard to prepare ATS-friendly documents that capture their qualifications and experiences and meet the requirements of the job posting. The creation of an automated system for customising CVs is extremely topical in the present-day digital recruitment environment, where efficiency and accuracy are crucial. The paper can help applicants save time, reduce human error, and improve the quality of their CVs by leveraging NLP and ML technologies.

Automation of CV tailoring also means the job applicant no longer needs to reassign their paperwork to each application, which is particularly useful when submitting several applications simultaneously [5]. Also, the suggested system may help job applicants pass through the ATS filters used in most recruitment operations. The system would increase the chances that a particular applicant will catch a recruiter's attention and eventually secure an interview by ensuring the CV aligns with the job requirements. Moreover, this paper has some greater applications in the recruitment sector. As human resource management is increasingly focused on AI and automation, the suggested system can serve as a reminder of how technology can be utilised to enhance the effectiveness and equity of the recruitment process. This system will help make the recruitment process more accessible and fairer for all job seekers by eliminating bias or unequal treatment in the job application process, since manual CV customisation is unnecessary.

2. Literature Review

The recruitment process has undergone digitalisation, transforming the way organisations source, assess, and select candidates. Human recruitment used to be time-consuming and subjective because recruiters had to review CVs and resumes manually. With the introduction of digital tools and automation, however, this process has been streamlined, enabling faster, more reliable, and data-driven recruitment. One of the main technological elements of the current recruitment process is the Applicant

Tracking System (ATS). This computerised solution simplifies the recruitment process by automating candidate data collection, processing, and filtering. ATS systems are generally implemented in organisations to aid recruiters and job seekers in managing and tracking job applications, screening candidates, and identifying the most desirable candidates for vacancies. The main aspect of ATS systems is that they operate using algorithms to sift through job applications and resumes, ranking and filtering applicants based on the quality of their CVs that fit the job description [6]. The major benefit of an ATS is that it saves the human recruiter a lot of work, as they can filter out a large number of candidates and lower the amount of workload by being automated, including in the process of sorting by resumes and keywords and filtering the candidates according to predefined criteria, including abilities and the suitable level of experience.

Consequently, ATS is important in assisting organisations to save time and resources whilst maximising the number of qualified candidates. Nevertheless, ATS systems have drawbacks, especially those that negatively impact job applicants. These systems typically use keyword filtering, meaning candidates need to tailor their CVs to the keywords in a job advert. If the applicant is qualified and has a strong CV but has not included the words or phrases in the job advertisement, the ATS may ignore the application. Such a reliance on keywords may overlook the finer points of human language, e.g., synonyms, different wordings, or contextually sensitive words. It may exclude qualified applicants due to slight variations in language use [7]. Thus, ATS systems can be very useful for streamlining the initial steps of the recruitment process. Still, they can introduce a bottleneck for prospective hires who cannot tailor their resumes to the specifics of the vacancy. When discussing Automated CV Customisation and Generation Systems, the ATS plays an essential role, underscoring the need for a solution that automates CV customisation without losing relevance or semantic accuracy. Such a system would make it easier for candidates to create ATS-friendly resumes by automating the CV tailoring process, reducing the likelihood of human error and increasing their chances of success in ATS filters.

2.1. Current CV Builder and Recruiting Solutions

Over the last 10 years, several CV builders and screening software have become available or are in development to assist job applicants in creating professional resumes and ensuring their suitability for the ATS. These applications usually offer a set of templates and formatting options that simplify the process of creating a visually appealing CV for applicants. Most such CV builders, however, are limited in what they can accomplish, especially in automating the customisation of CV content to suit job descriptions. Conventional CV editing tools like Novoresume and Zety emphasise the visual and technical aspects of resume building. Although such sites enable users to select from different templates, fonts, and designs, they do not significantly help optimise content for the ATS. All CV builders offer general advice on what to include in a CV. Still, they do not have intelligent matching functions that can match the candidate's experience and qualifications with the specific job opportunity. It implies that users will continue to manually tweak their CVs to align with the job description, which can be tedious and error-prone.

Conversely, ATS tools such as Jobscan and Resumake offer more specific options, including keyword matching [8]. Through these sites, users can post their CVs and job descriptions, then compare their CVs' compatibility with the job specifications. They provide recommendations to enhance the CV's keywords and identify where the CV may be insufficient in terms of relevance. Nevertheless, these tools do enhance the ATS compatibility of the CVs, though they require considerable manual input from the user. When submitting a job application, the job seeker is required to sift through the suggestions and amend their CV; this process may still be time-consuming when applying to multiple job adverts [9]. Although these tools are a significant advancement in helping candidates develop ATS-friendly resumes, they are not a complete form of automation. They offer useful features, including keyword analysis, but do not automatically generate CV content from a job description. The current systems lack a mechanism to dynamically adapt a CV's structure or content to the job description. This indicates a glaring gap that can be filled by an Automated CV Customisation and Generation System that intelligently processes job descriptions and compares them with a database of stored user profiles to produce fully customised, ATS-winning CVs with minimal user input.

Table 1: Comparative analysis of existing resume tailoring and optimisation systems

Tool / System	Core Functionality	Strengths	Limitations	Comparison to Proposed System
Novorésumé	Templatebased CV builder	Elegant templates, strong visual design, user-friendly UI	No semantic analysis; does Do not tailor a CV to a job descriptions; manual editing required	Your system provides automated job-specific tailoring + NLP-based matching

Zety	CV builder with keyword suggestions	Large library of templates; guided writing tips	Only surfacelevel keyword checking; no deep semantic job-CV alignment	Your system extracts the job requirements and rewrites content intelligently
Jobscan	ATS keyword matching	Strong ATS simulation; provides match percentage	Does not generate CVs; no personalized rewrites; only comparisonbased	Your system matches and generates a tailored CV automatically
Resume2Vec (Research)	ML embeddingbased Similarity scoring	High semantic accuracy; strong academic foundation	Not widely available; research prototype, no PDF generation or UI	Your system applies actionable NLP within a full workflow (input → match → CV)
ResumeFlow	Resume parsing / structured field extraction	Good at extracting skills, experience, entities	No ranking engine; no automated CV generation; no tailoring	Your system uses extracted info to actually Create a role-specific CV
Rezi	AI-assisted CV optimization	Some AI rewriting; ATS optimization	Limited transparency; generic rewrites; not job-specific	Your system performs evidence-based job-specific matching using extracted responsibilities

The analysis in Table 1 above shows that current commercial products are mainly focused on template-based CV construction or superficial keyword matching. Not many of them offer a unified pipeline that incorporates semantic job comprehension, user profile analysis, ranking, and automated PDF CV creation. This gap makes the proposed system more end-to-end and holistic, as it addresses ATS optimisation and personalised content rewriting.

2.2. NLP and Semantic Analysis of Recruitment

It has also been realised that Natural Language Processing (NLP) has become a crucial component in the automation of the recruitment process, enabling machines to learn and comprehend human language in a computationally useful manner. NLP is essential in the context of customising the CVs of the job applicants in terms of both the content and structure, in analysing the job descriptions, as well as analysing the candidate resumes to extract the crucial information and ensure that the CVs are in line with the job requirements. NLP is a collection of methods, including tokenisation, named entity recognition (NER), semantic analysis, and others, that enable machines to deconstruct and interpret text in a manner akin to how humans comprehend language. In tokenisation, text is divided into smaller components, such as words or phrases. In contrast, in stemming, words are reduced to their base forms (e.g., the word running is reduced to run) [21]. Named entity recognition is a technology that identifies important entities, such as company names, job titles, and educational institutions, in text, enabling systems to extract key information from resumes and job descriptions. Semantic analysis is one of the most powerful NLP methods used in recruitment because it enables the system to understand the meanings of words and phrases in context, rather than merely matching words to keywords.

Examples of such NLP models include Sentence-BERT and Word2Vec, which represent words and sentences as multi-dimensional points in vector space. The semantic similarity of the various pieces of a text is given by the distance between these points [11]. When comparing the job description with the candidate's resume this way, the system can identify how closely the applicant's qualifications match the job requirements, even when the words used in the resume differ slightly from those in the job description. Although the two conventional ATS systems rely heavily on keyword matching, semantic analysis offers a better approach for matching job descriptions with resumes. NLP models can identify synonyms and other context-relevant skills by understanding the meaning of words, which simple keyword filters cannot detect [22]. It is this semantic understanding of text that makes NLP a priceless asset in automating CV customisation since a system can generate not only a resume formatted to be compatible with an ATS but also one that makes semantic sense to the job description. In the Automated CV Customisation and Generation System, NLP would be at the centre of the text analysis process, enabling the system to

intelligently process job descriptions and user profiles to create customised CVs. Using semantic similarity methods, the system would ensure high-quality, relevant CVs that increase the likelihood of passing ATS filters while preserving the integrity of the applicant's qualifications.

2.3. AI-Based CV Customisation Systems

Lately, much attention has been paid to integrating the concepts of Artificial Intelligence (AI) and Machine Learning (ML) into CV customisation. The AI-based systems utilise advanced algorithms to analyse and process large datasets, identifying patterns and making decisions with little or no human intervention. Regarding resume customisation, AI could be applied to the system to generate personalised resumes based on the job description and other relevant information. The current AI-based tools for generating CVs, including Resume2Vec and Resume Flow, leverage machine learning to help job seekers maximise their CVs. An example of these models is Resume2Vec, which generates resume embeddings using deep learning and uses them to prioritise candidates and place them in the most appropriate vacancy based on semantic similarity. On the same note, Resume Flow also employs AI to suggest ways to improve the resume, using user feedback to enhance the CV over time. Although these systems are more automated and person-centred than conventional CV builders, users still need to input and respond significantly to the content to make any significant modifications.

The primary drawback of the current AI-powered CV customisation systems is that they are not usually designed to fully automate CV creation, but instead to enhance the relevance of the information presented. Most of these tools, including AI-powered platforms, continue to rely on user edits, particularly for content rewrites and formatting. They tend to place these systems as assistants rather than as full solutions for automating the CV creation process. The Automated CV Customisation and Generation System is expected to overcome this limitation by completely automating the CV creation. With the help of AI and NLP algorithms, the system will process the job description and match it to the stored profile to produce a personalised CV that is simultaneously ATS-compliant and semantically correct [26]. This system would provide a real AI solution by automating the necessary steps of CV customisation, allowing job applicants to apply to multiple jobs without manually tailoring their resumes to each job opening.

2.4. Technology Gaps

Even though AI has improved and NLP-based recruitment tools have been developed, technological gaps still prevent the automation of CV customisation. The analysis of job descriptions, matching profile data, and document generation is a key gap. Most systems on the market are keyword-matching, document formatting, or simply feedback loops, but lack a complete solution that automatically parses job descriptions, semantically reviews them, and generates fully customised CVs based on the profile of a specific candidate. The other major gap is the lack of semantic knowledge in most existing CV optimisation tools. Although traditional ATS systems use keywords to match, this approach does not account for linguistic differences, such as synonyms or context-specific words. Because of this, a pool of qualified candidates is eliminated due to a lack of the required terminology in their resumes, even though their qualifications fit well with the job requirements.

Being unable to perform semantic analysis with the available tools efficiently means candidates still have to manually modify their resumés to fit the specific language of job descriptions, which is inefficient and prone to error. Lastly, scalability and ease of use are some of the issues facing most existing systems. The tools used can be effective when applied to a single job, but when job seekers must apply to multiple jobs, they become cumbersome. The absence of an intuitive, scalable solution means applicants will continue to spend a lot of time customising their resumes, reducing the overall effectiveness of the process. The Automated CV Customisation and Generation System described in the given paper is expected to address these gaps by providing a complete, end-to-end system that combines job description parsing, profile data matching, and automated document generation. The NLP and ML will ensure that the generated CVs are not only compatible with the ATS but also semantically aligned with the job description, minimise the number of people involved in manual intervention, and make the entire application process more efficient.

3. Research Methodology

3.1. Research Design

The design of this study was an experimental, Design Science Research (DSR)-based study that involved designing a new system and empirically and scientifically testing it. The general purpose of the research was to design and develop an Automated CV Customisation and Generation System that used Natural Language Processing (NLP) and Machine Learning (ML) to automate the process of personalising CVs to fit the job description without compromising with Applicant Tracking Systems (ATS). The system was meant to offer a more efficient, quicker alternative to manual CV customisation, which is traditionally time-consuming and carried out by job seekers. The Design Science Research (DSR) method was particularly suitable, as the

paper involved the design, development, and appraisal of a new technological artefact. According to Iso et al. [12], DSR is a problem-solving model in which one forms an artefact, assesses its usefulness, and improves it based on feedback.

The artefact of this study was the Automated CV Customisation and Generation System, and the research focused on its development, implementation, and testing, using real job descriptions and anonymised CVs. The DSR approach facilitated the iterative development of the system, with each stage improved through continuous feedback and review. This aligned with the paper's objective of developing a functional tool to address the realities job seekers face in the recruitment process. Qualitative and quantitative evaluations of the system were conducted based on user feedback, ATS-compatibility tests, system performance indicators, and accuracy tests. Additionally, the study included an experimental component in which the system's performance was tested in real-world conditions by comparing the CVs generated by the system with manually adjusted CVs. The comparison examined the compatibility of ATS, its relevance to job descriptions, and its overall appropriateness for job applications [18]. In this process, the strengths and weaknesses of the developed system have been objectively evaluated in real job application contexts.

3.2. Data Collection

This paper will involve two major types of data in the data collection process: user profile data and job description data. The two data sets are necessary for training and testing the Automated CV Customisation and Generation System so that it can recreate users' qualifications based on job specifications and create CVs formatted for ATS systems.

3.2.1. User Profile Data

This information is structured data about the job applicant, including their skills, education, work experience, certifications, and any other relevant information. The information will be gathered through a web-based form, where users are requested to volunteer their information. The data on the user profile will be anonymised and stored securely to ensure privacy and ethical requirements are met. The data will be stored in a relational database using Entity Framework Core, and all data will be organised and made available for processing [13]. The information in the profile will serve as the basis for the CV customisation process, which the system will use to create personalised CVs tailored to the job description.

3.2.2. Data on Job Description

Job descriptions will be sourced from public sources, including job boards, company websites, and recruitment platforms. Users can also post job descriptions to the system. NLP will be applied to the job descriptions to identify the most important skills, qualifications, and job requirements. The system will use these descriptions as input to the matching algorithm, which matches job requirements with the user's profile to produce an optimised CV [14]. The job descriptions will be approached with caution, as with user data, to ensure no proprietary or confidential information is utilised during development and testing. Data collection will be conducted confidentially and transparently, with all participants willing to allow their data to be used in research. The study will be conducted in accordance with all applicable ethical standards, such as GDPR compliance, to ensure that no information is compromised or abused [24]. The user information will also be anonymised to avoid any risk of identification, and participants will have control over their data. They can choose to remove their profiles from the system at their own time. System development/evaluation was done using 15 anonymised user profiles and 50 job descriptions. The volunteer participants and test data sources were used to collect user profiles, while job descriptions were sourced from public job boards (LinkedIn and Indeed). This was a large enough Design Science Research (DSR) prototype, with the aim of refining and validating functions iteratively rather than statistical generalisation at scale.

3.3. System Architecture and Workflow

The Automated CV Customisation and Generation System have a multi-tier structure, characterised by the cooperation of its various system elements to achieve smooth processing, job description analysis, CV generation, and output delivery. It consists of three major layers:

3.3.1. Frontend Layer (User Interface)

The front of the system is created with Blazor Server or ASP.NetMvc provides a web-based interface for end users to enter their profile information and job description. This layer communicates with the backend via APIs to transmit and receive real-time data. Its user interface is intuitive and user-friendly, and the applicant can post job descriptions and complete their personal details in a short period of time.

3.3.2. Backend Layer (Business Logic and NLP Processing)

The backend layer is built on ASP.NET Core, which serves as the primary layer for developing APIs that process data and communicate with the database. Job description, user profile processing, and the execution of the relevant algorithm to acknowledge skills and qualifications are handled at the business logic layer. It also generates CVs by translating the corresponding data into an ATS-compliant CV document.

3.3.3. Database Layer (Data Storage and Retrieval)

User profiles and job descriptions are stored in a database, ensuring the data is well-organised and readily available. SQL Server database management is handled through Entity Framework Core, which provides an object-relational mapping (ORM) for data interactions [15]. This layer assures user and job data are easily accessible and can be processed as needed. The system works in the following way:

- **Creation of the User Profile:** Users enter their personal details via a web form. The database contains this data and serves as the foundation for the customisation process.
- **Input:** Users post a job description or enter text into the system. The job description is processed using the NLP module to identify the relevant skills and other qualifications, as well as job requirements.
- **Semantic Matching**: The system is powered by the Sentence-BERT model, combined with ONNX Runtime, to convert both the job description and user profile data into vector representations. The similarity between these embeddings is then measured using cosine similarity to assess the fit between the user's qualifications and the job requirements.
- **Generation of CV:** Based on the semantic match, the system generates a customised CV in DocX (Word) and QuestPDF (PDF) formats. The CV is designed to be ATS-compliant, meaning it should follow formatting standards and rules, such as keyword density, the absence of tables, and proper use of headings.
- **Output Delivery:** The system will deliver the generated CV to the user, who can download it in the required format (Word or PDF).

3.4. NLP and Matching Algorithm

The NLP and matching algorithm are the core of the Automated CV Customisation and Generation System, which processes textual information from job descriptions and user profiles to create a customised CV. It can be divided into several steps:

- **Text Preprocessing:** This is followed by preprocessing the raw job descriptions and user profiles, then putting them in a format that can be analysed. This involves tokenisation (cutting text into words or phrases), removal of stop words (cutting irrelevant but common words out of the text, such as "the" and "a"), and stemming (cutting words down to their root form, e.g. "running" is reduced to "run") [16]. These preprocessing measures would be necessary to standardise the text and make the algorithm target meaningful content.
- **Feature Extraction:** ML.NET is applied in this stage to extract significant text features. These characteristics are keywords, skills, qualifications, and job-specific phrases relevant to the user's profile. The extraction process helps the system identify the most significant elements of the job description and the user profile.
- **Semantic Embedding:** Using the Sentence-BERT model, the system converts the job description and user profile into vector representations. Words or phrases are represented by a point in a multi-dimensional space, where similar words will be placed near each other. This enables the system to extract semantic meaning rather than just keyword matches. The embeddings provide a more detailed view of how the job description and user profile relate to each other.
- **Similarity Calculation:** The cosine similarity formula is used to compare the job description and user profile by comparing their vector embeddings and determining their similarity. What is obtained is a similarity score that reflects the extent to which the user's qualifications meet the employment requirements. The more similar the scores are, the more they will be matched.
- **Ranking and CV Generation:** The system ranks the user's qualifications and experience based on the job description, using similarity scores. The most pertinent data, in turn, is emphasised in the resulting CV, which is ATS-friendly formatted.

3.5. Tools and Technologies

The Automated CV Customisation and Generation System leverages powerful tools and technologies, enabling it to process user data and job descriptions and to generate CVs efficiently. These tools include:

- **ASP.NET Core:** ASP.NET is the primary backend framework for building APIs and business logic in the system. ASP.NET Core is a cross-platform, high-performance framework ideal for developing web applications and APIs.
- **Blazor Server:** A web framework that is used to develop a user interface. Blazor Server enables developers to build interactive web applications with C# and Razor components, thereby improving the user experience through a smooth, responsive interface.
- **ML.NET:** This is a machine learning platform that performs feature extraction and similarity computation. ML.NET provides the tools to build your own machine learning models and run NLP tools on the data, e.g., tokenisation and vectorisation.
- **ONNX Runtime:** It is a component used to load and execute pretrained transformer models, such as Sentence-BERT, which are required to create embedding vectors and calculate semantic similarity between job descriptions and user profiles.
- **DocX and QuestPDF:** These are open-source libraries that are employed in creating ATS-compliant CVs in Word and PDF formats. DocX can dynamically create documents, while Quest PDF produces high-quality, formatted PDFs.
- **SQL Server and Entity Framework Core:** The data storage and management tools for user profile and job description data. SQL Server offers a robust relational database platform, and Entity Framework Core simplifies data access and management with an ORM.

3.6. Evaluation Plan

The Automated CV Customisation and Generation System evaluation plan was created to be strict in evaluating the performance, reliability, and usefulness of the developed artefact. As the Design Science Research (DSR) principles state, the assessment aimed to evaluate four basic dimensions: functional correctness, system performance, the relevance and accuracy of the produced CVs, and end-user experience [17]. Such a combination of evaluation stages provided technical and user-based information on the system's effectiveness in fulfilling its purpose.

3.6.1. Functional Testing

The evaluation process relied on functional testing to ensure that each module in the system met its specifications. The system consisted of multiple interdependent parts, including the User Profile module, Job Description Analysis, Matching and Ranking Engine, CV Generation Engine, and ATS Optimisation Layer. Unit and integration testing were performed on each module separately and collectively. Unit testing was part of validating each module's correctness individually [1]. For example, the User Profile module was tested to ensure that user information, including skills, education, and experience, was properly entered using the Blazor forms, verified, and stored in the SQL Server database via Entity Framework Core. On the same note, the Job Description Analyser was also tested to verify that preprocessing stages, such as tokenisation, stop-word removal, and keyword extraction, were functioning properly using a set of job descriptions from various industries. The Matching and Ranking Engine was tested in units to confirm that the semantic similarity calculations using Sentence-BERT embeddings were correct. After unit testing, integration testing was conducted to ensure the smooth coexistence of modules [19]. This kind of testing was essential, as the system relied on the seamless flow of data between the user input and the components that generate the final report. Integration tests tested the full workflow of creating a profile, uploading a job description, executing the corresponding algorithm, and producing an ATS-compliant CV without failure or data loss. The findings confirmed effective communication among modules, and any errors detected in the initial stages were corrected during debugging and system refinement.

3.6.2. Performance Evaluation

Performance testing was conducted to determine the system's ability to operate effectively in real-world conditions. Key performance indicators such as response time, scalability, and resource utilisation were considered. Response time was measured at key points in job parsing, semantic matching, and CV generation. The system, under normal use conditions, could consistently produce a CV in a few seconds, thereby meeting the usability requirement of users who may need to create many customised CVs in a short period. The benchmarks showed high performance across a range of job descriptions and user profile complexities. Scalability was evaluated through stress testing, with several simulated users performing operations simultaneously. This test simulated the real environment, where large groups of job applicants could be in the system at the same time. Stress tests showed certain bottlenecks, including slowness in PDF rendering under high load. The bottlenecks have been resolved by optimising database queries and enhancing caching. The post-optimisation tests also indicated that the system responded effectively to concurrent requests, with no significant drop in speed. Resource utilisation was monitored to ensure the system would keep running even on machines with limited computing power. CPU and memory usage were observed when servers were under heavy load due to long job descriptions or the creation of multiple CVs, and remained within acceptable bounds. This meant the system could be deployed on a scale without specialised hardware.

3.6.3. Accuracy and Relevance Evaluation

The evaluation of accuracy and relevance assessed the system's ability to align user attributes with job requirements. Precision and recall were 2 key metrics used to evaluate the Matching and Ranking Engine's performance. Precision was used to measure the percentage of qualifications emphasised in the created CV that were relevant to the job description, and recall was used to measure the percentage of relevant job requirements that the system identified. System-generated CVs were then tested against manually prepared CVs prepared by human professionals, serving as the gold standard, to develop a benchmark. The discrepancies between system outputs and human-specific outputs were identified, and the rules for keyword extraction and the semantic similarity threshold were amended accordingly. The reviewers also reviewed the content structure of the generated CVs to ensure the most significant qualifications received the necessary priority. The analysis showed that the system was highly precise in identifying technical skills and moderate in identifying subtle job conditions.

3.6.4. User Evaluation

The user review was important in determining the usefulness and readability of the generated CVs in practice. The comparison was based on user satisfaction, perceived clarity of the CV content, formatting quality, and perceived ATS-friendliness. An organised user study was conducted with a sample of 8 individuals, comprising both final-year students and early-career IT professionals. The participants were asked to complete three activities: enter or review their profile, upload a job description, and create a tailor-made CV. The participants were then rated against the output in terms of readability, relevance, structure, formatting, and satisfaction. The survey used a 5-point Likert scale and included an optional written comment. The participants also noted that the generated CVs were consistently well-structured, professionally written, and job-oriented. The feedback played a critical role in enhancing the wording of the experience descriptions, section spacing, and keyword placement to improve compatibility with ATS. The findings indicated that users found the system easy to use, effective, and very supportive in creating various application-ready CVs

3.7. Ethical and Legal Considerations

3.7.1. Data Privacy

Since the paper is sensitive and contains personal information about job seekers, data privacy will be of the utmost importance. This system will comply with data protection regulations, especially the General Data Protection Regulation (GDPR), to protect user data and to be responsible in managing their data during the development and evaluation process. Any personal information provided by users, e.g., contact information, educational history, experience, and skills, will be anonymised before use in testing and development to avoid any form of identification. Moreover, the information would be stored securely and accessed only by authorised personnel. Data at rest and in transit will be encrypted to ensure personal information remains confidential and safe.

3.7.2. Informed Consent

Users will have to make informed consent before any data is collected. It implies that customers will understand the transparency of their data utilisation in full and receive the right to revoke this consent. Users will also be able to remove their profiles and related data from the system if they choose. This puts personal information under the user's control, so the user cannot be sure of all the activities involving the information [8]. The system will also provide clear information about the data collection process, including the duration of time their data will be stored, how it will be utilised in testing and development, and the measures in place to secure their data.

3.7.3. Transparency

Another ethical consideration in this paper is transparency. Users will be advised of the decision-making process used by the system when customising their CV. The system will ensure transparency in its decision-making processes, especially in matching job descriptions to user profiles. Specifically, users will have access to the information about the qualifications and skills in their profile that the generated CV highlights, as well as how these aspects of their profile align with the job description [13]. Such openness will help gain users' trust and leave no doubt that they understand the logic of the system's CV generation process.

3.7.4. Ethical Use of Data

All data used in the paper's development and testing processes will be either synthetic or anonymised. No proprietary or confidential job descriptions or user profiles will be used without express permission. This code of ethics is necessary to ensure

user privacy and prevent the abuse of personal or confidential data. These ethical practices will ensure the paper treats user data with due care and in line with the legal and ethical standards set. Finally, the evaluation plan will provide a detailed assessment of the Automated CV Customisation and Generation System across functional performance, accuracy, user satisfaction, and ethical data handling, including assessments, user reviews, and strict adherence to ethics.

3.7.5. System Development and Implementation

The development of the Automated CV Customisation and Generation System is an iterative, incremental design based on Design Science Research (DSR) principles. DSR is especially appropriate for this paper because it aims to develop artefacts to solve practical issues, test them, refine them based on real-world feedback, and ensure they can be used. The process of developing the system will include several steps based on experience gained from previous steps, allowing the system to be optimised and continually improved. Using this methodology, the system can be developed through testing and validation, resulting in a final product that meets the desired goals of automated CV generation and ATS optimisation. The system comprises several key modules that perform specific tasks within the broader CV generation process. The User Profile System will be responsible for capturing and storing user information, skills, experience, education, and other qualifications.

The NLP-based Job Description Analyser automatically processes job ads to extract their key requirements, and the resulting CV is specific to that job. The Matching and Ranking Engine will match the user's profile to the extracted job description and select the most relevant qualifications and experiences to include in the CV. The CV Generation Engine then customises the tailored CV into an ATS-compatible structure, ensuring it is best practice for automated recruitment systems. The ATS Optimisation Layer ensures the generated CV adheres to ATS formatting rules, including keyword density and structure. Finally, the User Interface (UI) is built with Blazor. It provides a convenient, user-friendly web interface that lets people enter their information, submit job descriptions, and receive their personally formulated CVs. It depends on the .NET ecosystem: ASP.NET Core for the backend, ML.NET for machine learning, ONNX Runtime to run pre-trained models such as Sentence-BERT, and QuestPDF to create professional, ATS-compliant CVs. All these technologies have been chosen for their scalability, performance, and integration capabilities, enabling seamless interaction among all modules.

4. User Profile System

4.1. System Requirements

The Automated CV Customisation and Generation System is built on the User Profile System, which stores and records detailed information about the user, including their skills, work experience, education, certifications, and accomplishments. The functional requirement of this system is the ability to handle a broad spectrum of user data, providing flexibility in the kinds of information users can provide. This is not only in basic data points such as personal information, but also in more detailed data such as paper descriptions, skills, and certifications [20]. The system should enable users to add, update, and manage their profiles without much hassle, ensuring their CVs are up to date with the latest available information. The User Profile System has non-functional requirements related to data integrity, security, and extensibility. As user data is sensitive, the system should handle the information securely and ensure it cannot be accessed by unauthorised personnel. Moreover, the profile structure must be ATS-ready; that is, the data must be organised so it can be easily extracted and compared with job descriptions. This organisation will ensure that any generated CV is properly formatted and optimised for ATS.

4.1.1. Database Schema Design

The database scheme for the User Profile System is based on SQL Server and Entity Framework Core (EF Core) to ensure data is managed and retrieved effectively. The database will be based on some significant tables/entities that illustrate each dimension of the profile of the user:

- **Users:** This contains personal information such as names, contact details, and usernames.
- **Work Experience:** The Stores contain the user's work history, including job titles, companies, and dates of employment.
- **Education:** This includes the user's academic history, such as institutions, degrees, and graduation dates.
- **Skills:** A list of the user's professional skills, including both soft and technical skills.
- **Certifications:** Follows all the certifications or qualifications the user has received.
- **Papers:** Stores data on the papers the user has worked on in the past, including descriptions, applied technologies, and results.

All the tables in the database are also normalised to remove redundancy, and foreign key relationships ensure that data is always consistent and easier to access. To illustrate, the Work Experience Table will be linked to the Users Table via a foreign key, so

that each user's work history is properly linked to their profile. This relational design also ensures the system is efficient in querying the database to retrieve the pertinent data needed to generate the CV.

4.1.2. Data Input and Validation

User profile data will be collected via a Blazor frontend that provides a simple, convenient web interface. Users can enter their data in predefined forms, and each field is configured to accept a specific data type (e.g., text fields for job titles, date pickers for dates of employment). The system will include validation rules to help ensure the input is correct and complete. To illustrate, the email address will be checked by regular expressions (regex), and the length check will also be made (minimal length) to ensure that the description of the work experience or the skills is sufficient. The system will also ensure that validation errors are reported in real time, and the user will be notified so they can rectify them before submitting their data. This is aimed at making the data entry process as simple as possible while ensuring the high quality and appropriateness of the information used to produce a definite and appropriate CV.

4.1.3. Profile Retrieval and Profile Storage

CRUD (Create, Read, Update, Delete) operations implemented with Entity Framework Core will be used to store profile data in the relational database. EF Core provides an abstraction layer that makes SQL Server databases easier to interact with, enabling easier storage and retrieval of user data. When users update their profiles, the system will utilise EF Core to reflect the changes in the database on demand. The NLP matching module requires efficient querying, with user profile data retrieved quickly and accurately during CV generation. The database schema will also be optimised to make the system as fast as possible by indexing frequently accessed fields (skills, work experience, etc.) so that relevant information can be retrieved with low latency.

4.1.4. Challenges and Solutions

There are several difficulties in handling and processing user profiles:

- **Unformatted Skill Descriptions:** Skills can be added to the system by individuals in many formats, making it hard to have a standardised skill that can be compared with job descriptions. To overcome this, the system will use text normalisation methods such as stemming and lemmatisation to standardise skill descriptions.
- **Unfinished Profiles:** Some users may have incomplete or no information, which may affect the precision of the generated CV. To curb this, the system will display prompts urging users to complete all fields and issue warnings if necessary when data is missing.
- **Coherence among CV Templates:** CV templates may use different formats to present information. To maintain consistency, the system will use a standardised data model that can be translated into any template, ensuring the user's profile is properly reflected in all created CVs.

4.2. NLP Pipeline (Job Description Analyser)

4.2.1. Purpose and Requirements

The Job Description Analyser is a critical component of the system that extracts key information from job postings to generate CVs. This module primarily aims to convert raw job descriptions into structured, machine-readable formats that can be compared with the user's profile [23]. This includes identifying the required skills, qualifications, and experience stated in the job description, as well as any tools or technologies needed to perform the job. This module requirement is the ability to handle a wide range of job descriptions, limited only by industry and occupation, to ensure the system can be used for any job offer.

4.2.2. Preprocessing Pipeline

Job Description Analyser starts by preprocessing the raw text of the job description. This entails a procedure comprising the following things:

- **Lowercasing:** Standardise the text so it is case-insensitive.
- **Stopword Removal:** Removal of common words that are not informative, like the, and, and " is.
- **Eliminating Punctuation:** Eliminate the punctuation marks which do not add to the semantic meaning.
- **Tokenisation:** ML.NET libraries can be used to split text into smaller units (tokens), which are either words or phrases.

Such preprocessing measures would ensure the text is clean and ready for further processing, helping the system extract meaningful information.

4.2.3. Keyword Extraction

The identification of the most relevant job description words and phrases is the process of keyword extraction. This may be accomplished using a dictionary-based method (e.g., finding an existing element in a dictionary, such as a programming language or job title) or regular expression rules to identify a common pattern in the text (e.g., a date, a skill level). Moreover, machine learning techniques, including named entity recognition (NER), can be used to recognise entities such as company names, places, and educational institutions.

4.2.4. Semantic Embeddings

Sentence-BERT (implemented using ONNX Runtime) is used in the system to transform both job descriptions and user profiles into vector embeddings. These embeddings represent the meaning of the text in a multi-dimensional space, where content can be compared based on semantic similarity. The cosine similarity is then applied to the vectorised representations to determine the relevance of various parts of the job description with reference to the user profile.

4.2.5. Role Requirement Identification

The analyser has identified essential and preferred skills, tools, and technologies, enabling the system to prioritise the most significant criteria when creating the CV. For example, if the job description lists Python as a required skill, the system will recognise it as a mandatory requirement and compare it with the user profile.

4.2.6. Limitations of NLP Approach

Regardless of its strength, the NLP-based process has drawbacks:

- **Poor Job Descriptions:** Job descriptions can be written in different ways, which may result in unclear identification of some skills or qualifications.
- **Over-generalisation:** Transformer models such as Sentence-BERT can struggle with extremely specialised or domain-specific language (e.g., legal or medical).
- **Domain-Specific Roles:** In a niche area, the system may need specialised dictionaries or job training to ensure job descriptions are read accurately.

The limitations will be overcome through ongoing model advancement, including training on domain-specific datasets and using more advanced NLP methods where required.

4.3. Matching and Ranking Engine

The Automated CV Customisation and Generation System includes the Matching and Ranking Engine. Its main role is to match the job description's extracted job requirements with the users to determine the most relevant qualifications, skills, and experiences for the job. This process will allow the system to give greater priority to the most relevant details of the user profile, ensuring the created CV is highly relevant to the employer's needs. The applicant will also have a high probability of passing the ATS filters and capturing the recruiter's interest. The engine uses an advanced cosine similarity algorithm to assess the semantic overlap between the job description and the user's profile. With machine learning models such as Sentence-BERT, the system can learn and compare the context of a job description with the user's qualifications. The process converts what might have been a manual, subjective endeavour into an automated, objective one, which can be scaled to multiple job applications with ease.

4.3.1. Computation of Cosine Similarity

The mathematical method of measuring similarity between two vectors is called cosine similarity. Sentence-BERT is applied in the case of the Matching and Ranking Engine to create embeddings of the job description and profile of the user. These embeddings represent text as a multi-dimensional space, where the location of any word or phrase is defined by its semantic meaning. The next step is to determine the cosine of the angle between two vectors; the smaller the angle, the greater the similarity between them:

- The dot product of the two vectors gives the numerator that measures their alignment.

- Their product is the denominator, so that the result is normalised and does not depend on vector length.

This formula returns a similarity score between 0 and 1, with 1 indicating a high level of semantic correspondence. The matching engine reorders the user's qualifications based on this score, giving the most pertinent skills, experiences, and qualifications priority in the CV.

4.3.2. Relevance Scoring Model

The Relevance Scoring Model ranks the user's qualifications based on cosine similarity; the closer the user is to the job description, the higher the qualification's ranking. Everything in the user's profile, including skills, work experience, education, and certifications, is assessed for its applicability to the job requirements. The model prioritises:

- **Maximum Cosine Similarity Scores:** This is because the ranking of items based on their similarity scores to each other is the highest, which means that the most applicable qualifications would be the first ones to be generated in the CV.
- **Skills Match Experience Match:** Skills, especially those clearly stated in the job description, are given higher priority than work experience. This is because skills tend to be the best indicator of job aptitude, particularly in positions that require specific technical skills.
- **Recency-Weighted Work History:** The system weighs work history by its relevance to more recent experience, assuming that recent experience is usually more relevant to current job needs. The old jobs might still be useful, although their weight is diminished. The relevance scoring model ensures the most relevant qualifications are represented in the CV, increasing the likelihood of overcoming the ATS filters that, in many cases, prioritise relevant skills and experience.

4.3.3. Output for CV Generator

After the matching and ranking process is complete, the Matching and Ranking Engine will produce a sorted list of ranked items in an organised form, which is sent to the CV Generation Engine. The resulting output will be the most relevant skills, experiences, and qualifications, ranked by their relevance to the job description. The CV Generation Engine utilises this list to fill the dynamic parts of the CV template. To keep the CV as short and pertinent as possible, the final output excludes items with relevance scores below a predefined threshold (e.g., 50% similarity). This process eliminates unnecessary details from the CV, making it very specific to the essential qualifications outlined in the job description.

4.4. CV Generation Engine

4.4.1. Introduction to Document Generation

The CV Generation Engine will translate the structured information presented by the Matching and Ranking Engine into an ATS-friendly, well-formatted CV. The system uses a mixed approach to generating documents, using QuestPDF to produce PDFs and DocX to produce Word documents. With this hybrid method, users can download their customised CVs in various formats, making the CV more flexible for sharing or submission. QuestPDF and DocX have been chosen because they produce high-quality, readable documents in professional form and can thus be used by ATS systems. QuestPDF excels at producing PDFs that preserve formatting quality across devices, whereas DocX is a flexible format widely acceptable to recruiters and hiring managers.

4.4.2. Template Architecture

The system's CV templates are optimised for ATS, ensuring the CVs generated are formatted to meet the requirements of most applicant tracking systems. The notable characteristics of the template architecture are:

- **Table-Free:** Tables are avoided in the CV to prevent ATS systems from misinterpreting the information.
- **Well-Defined Headings:** The section headings, such as Experience, Education, and Skills, are well-defined, allowing ATS systems to extract and organise information easily.
- **Basic Font Design:** The system uses simple fonts that are easy to read and compatible with ATS, and it avoids complex formats that may confuse ATS parsers.
- **One-Column Layout:** The layout follows best practices for ATS compliance and uses a single column, with content organised in a simple, linear way.

- **Placeholders for Dynamic Entries:** The templates also include dynamic content placeholders such as work experience, skills, and education, allowing the system to add the user's information directly to the appropriate sections of the CV.

4.4.3. Dynamic Content Mapping

CV Generation Engine. This engine dynamically maps the ranked qualifications, skills, and experiences from the Matching and Ranking Engine to the appropriate sections of the CV template. This dynamic mapping process would ensure that the latest and most relevant qualifications are brought to the fore [24]. The CV structure is automatically adjusted based on the amount of content, and each section occupies the appropriate space on the page. The system also automatically prioritises a match, highlighting the most relevant skills or experiences in a visually distinct way, likely to capture the recruiter's attention.

4.4.4. ATS Compliance Features

The CV Generation Engine comprises several options that will help to optimise the generated CV to pass through ATS:

- **Bullet Points Optimised for Parsing:** Bullet points apply to the listing of skills and experience, since ATS systems generalise bullet-pointed information better than large paragraphs.
- **Elimination of Graphics, Icons, and Tables:** graphics, icons, and tables are not used because this makes the CV machine-readable to ATS systems, which in most cases do not comprehend non-text components.
- **Keyword Density Tests:** The system will ensure that relevant keywords, especially those in the job description, are used in reasonable amounts and not overused to enhance ATS compatibility.

4.4.5. Multi-Format Export

The CV Generation Engine facilitates the exportation of the customised CV to two formats:

- **PDF:** PDFs are created using the QuestPDF library to produce high-quality, device-compatible PDFs. The use of PDFs can be viewed as a professional and convenient way to share.
- **Word (docx):** The DocX library is used to create Word documents, which are a widely recognised format for job applications, particularly when the job position needs to be edited or configured.

The differences between PDF and DOCX are mostly in formatting. The difference between PDFs and DOCXs is that the visual interpretation of the CV is precise in PDFs. In contrast, in DOCXs, it can be edited and slightly altered in terms of formatting depending on the application one uses to open the document. The two formats ensure the resulting CV is ATS-friendly and professional.

4.4.6. Testing CV Accuracy

After creating the CVs, the system cross-checks them against several ATS tools to ensure that the formatting and content are properly parsed. This involves testing the CV using industry-standard ATS systems to ensure it meets key ATS feature standards, such as keyword recognition, heading structure, and content classification. The system also makes the metadata in the CV machine-readable, which is why it is important for ensuring that ATS systems can interpret and rank the CV content properly.

4.5. Integration ATS Optimisation

4.5.1. ATS Constraints and Requirements

Introducing ATS optimisation into the CV creation process ensures the product complies with ATS regulations. These rules include:

- **One-Column Layout:** This layout is favoured by ATS systems since it is easier to scan.
- **Basic Headings:** There are standard section headings, such as experience, education, and skills, to ensure the ATS recognises and classifies the material accordingly.
- **No Text Boxes and Tables:** ATS systems are not always able to read text boxes and tables, so they do not appear in the CV [4].

- **Use of Standard Fonts:** Standard machine-readable fonts such as Arial or Times New Roman are used to ensure that ATS systems can read them.

4.5.2. Density and Placement of Keywords

To increase the likelihood of clearing ATS filters, the system can include the necessary keywords (as recognised in the job description) in the CV in a natural, relevant manner. The keywords are included in the experience descriptions, and there are no issues with the CV or the terms entered by the ATS. Another component of the system is optimal keyword density checking to ensure the relevant skills and qualifications are visible without being overstated.

4.5.3. Structural Compliance

The system makes sure that the generated CV meets general ATS structural requirements, including:

- The headings were mapped to such categories as Summary, Experience, Skills, Education, and Certifications.

Such well-defined elements help ensure the ATS can easily read the CV, increasing the likelihood that an applicant will be rated highly by the system.

4.5.4. Comparison with Real ATS Tools

The last stage of ATS optimisation is testing the system-generated CV against real-world ATS tools, including Jobscan. By simulating how ATS systems read and analyse CVs, the system can identify areas for improvement and ensure the CV it generates is the best fit for real-world job application processes. With these metrics, the system continues to optimise the ATS process to achieve high success rates and increase the likelihood that applicants pass the first-stage ATS screening.

5. Evaluation and Result

5.1. Functional Testing

The element is important in evaluating the effectiveness of the Automated CV Customisation and Generation System. This is the stage at which it can be checked that all the system's main modules work as planned and form a harmonious tool [4]. The system comprises several interconnected modules, including the User Profile System, Job Description Analyser, Matching and Ranking Engine, CV Generation Engine, and the ATS Optimisation Layer. Figure 1 shows the front page of AutoCV.Web application with sidebar navigation with modules like Profile, Skills, Education, Experience, Job Descriptions, and Generate CV. The main content area shows the welcome message. So, users have a simple, intuitive interface to manage their resume materials and generate professional CVs

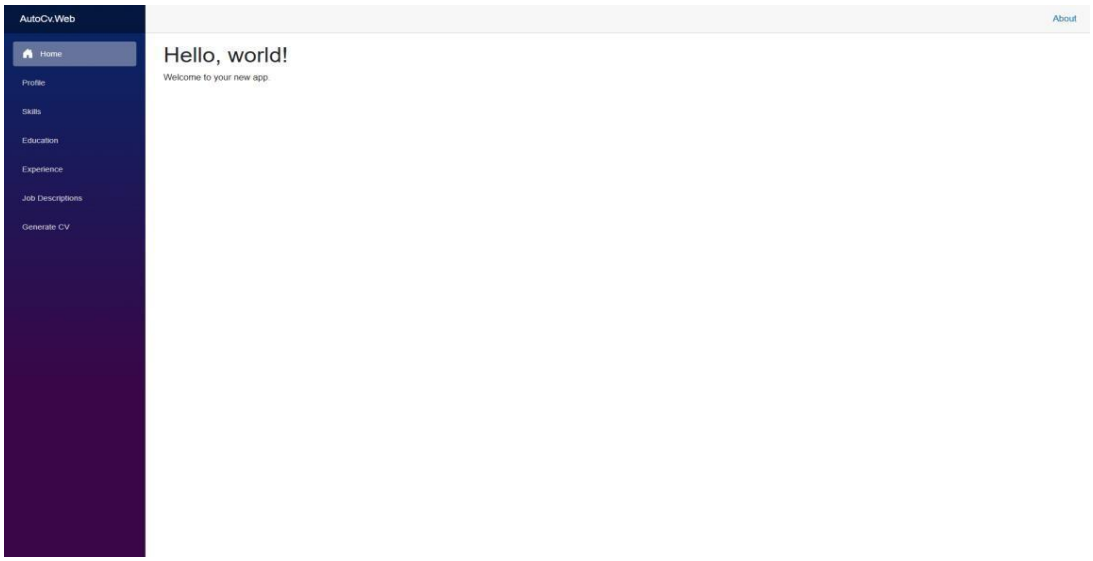

Figure 1: System dashboard showing navigation to all modules (profile, skills, education, experience, job descriptions, and generate CV)

The modules themselves have their own requirements and tests, and unit tests test them in isolation, while integration tests test them in combination (Figure 2).

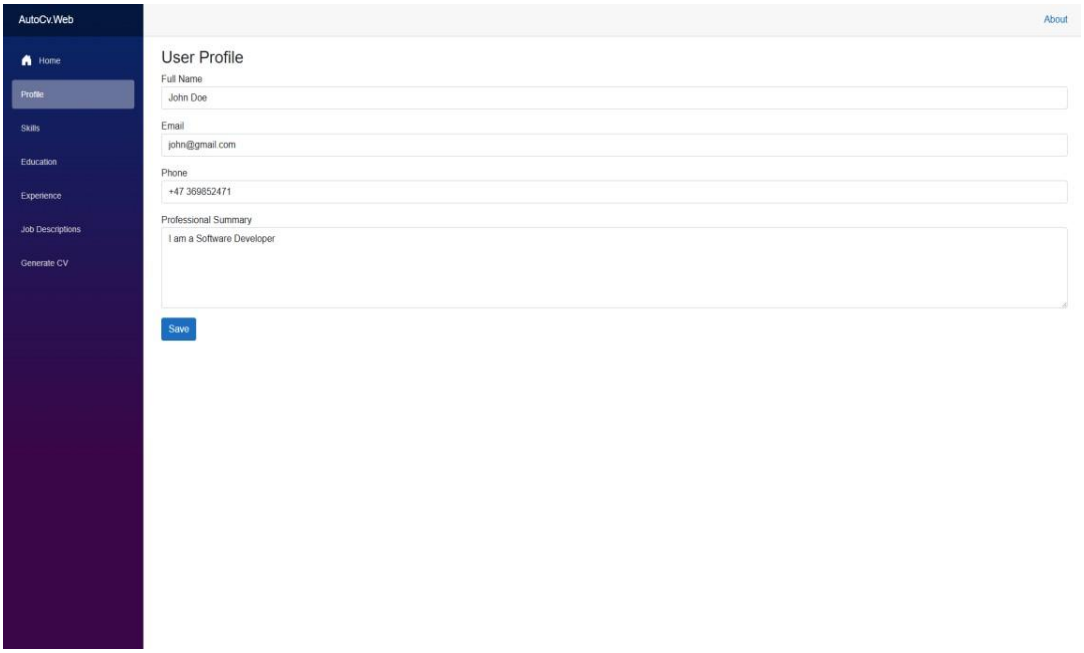

Figure 2: User profile module showing fully populated user information and edit form validation

Unit testing aims to ensure that modules work correctly [25]. Indicatively, in the User Profile System, unit tests verify that user information on skills, experience, education, and certifications is properly incorporated, verified, and stored in the database (Figure 3).

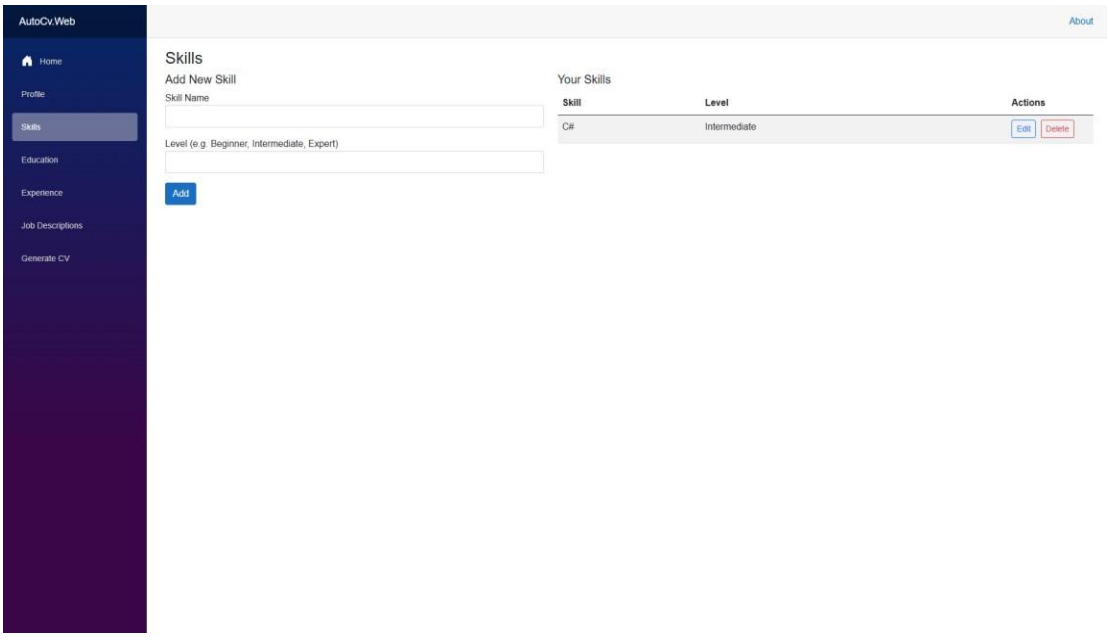

Figure 3: Skills module displaying add/edit/delete functionality

On the same note, the job description analyser includes unit tests to ensure that the preprocessing steps, including tokenisation, semantic matching, and forbidden words removal, are working correctly (Figure 4).

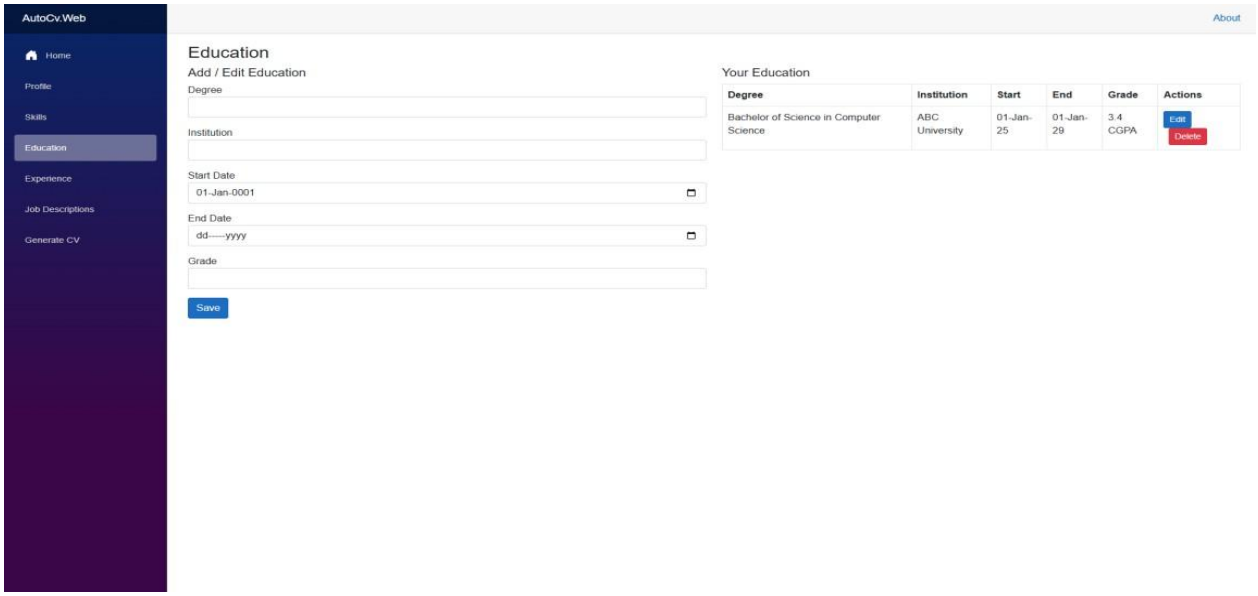

Figure 4: Education module showing saved entries

An independent test is run on each module to ensure it executes the activities it was created to perform without errors (Figure 5).

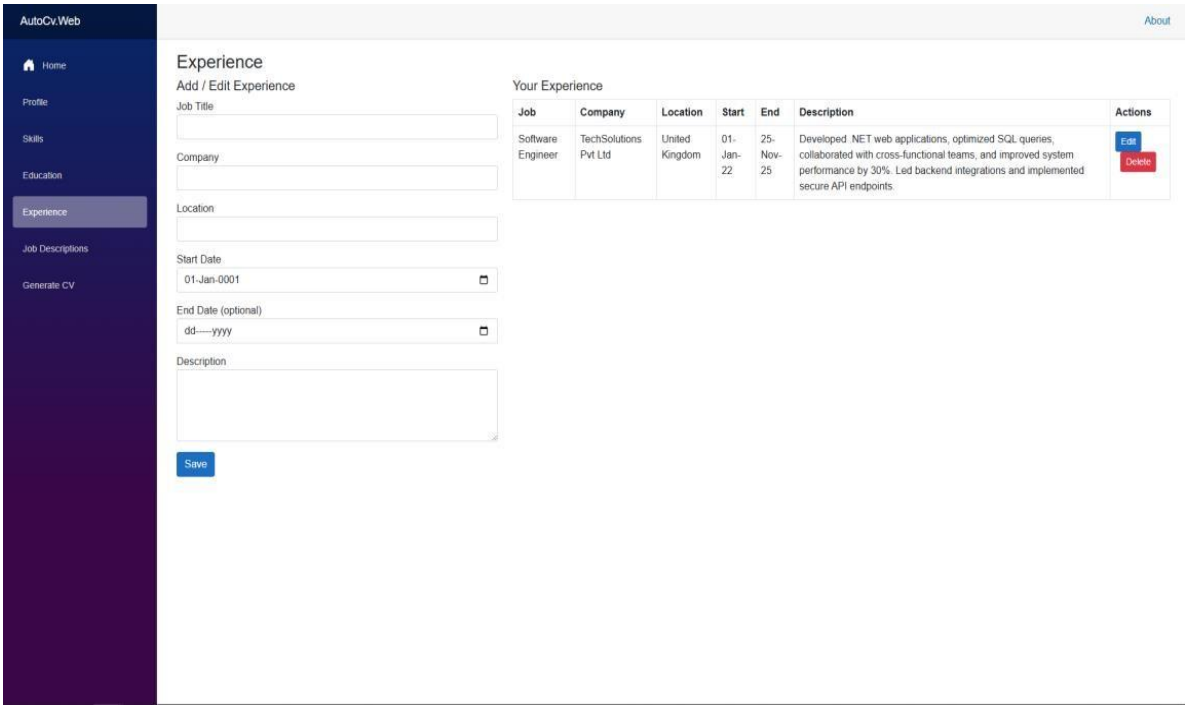

Figure 5: Experience module demonstrating correct record insertion

After unit testing, integration testing is performed to analyse module collaboration. As the system relies on efficient data transmission between the frontend and backend components, integration testing has focused on the correct transfer of data from the Blazor User Interface to the backend systems (Figure 6).

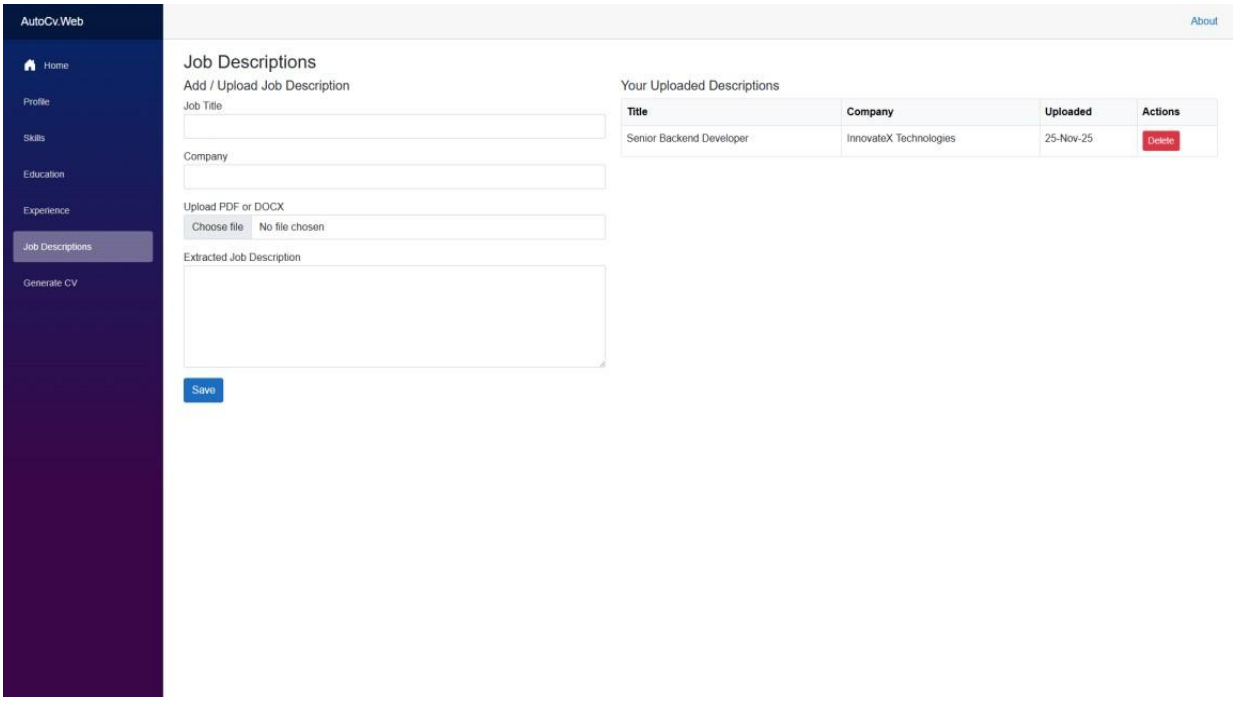

Figure 6: Job description upload interface showing extracted text

Indicatively, once the Matching and Ranking Engine has processed the user profile and job description, the output should be correctly fed into the CV Generation Engine. Besides, the ATS Optimisation Layer should be incorporated with the other parts of the system so that the CV generated meets ATS guidelines. Integration tests also aim to ensure complex workflows, including profile creation, job parsing, semantic matching, CV generation, and final download, occur in the proper order, resulting in a usable, optimised CV (Figure 7).

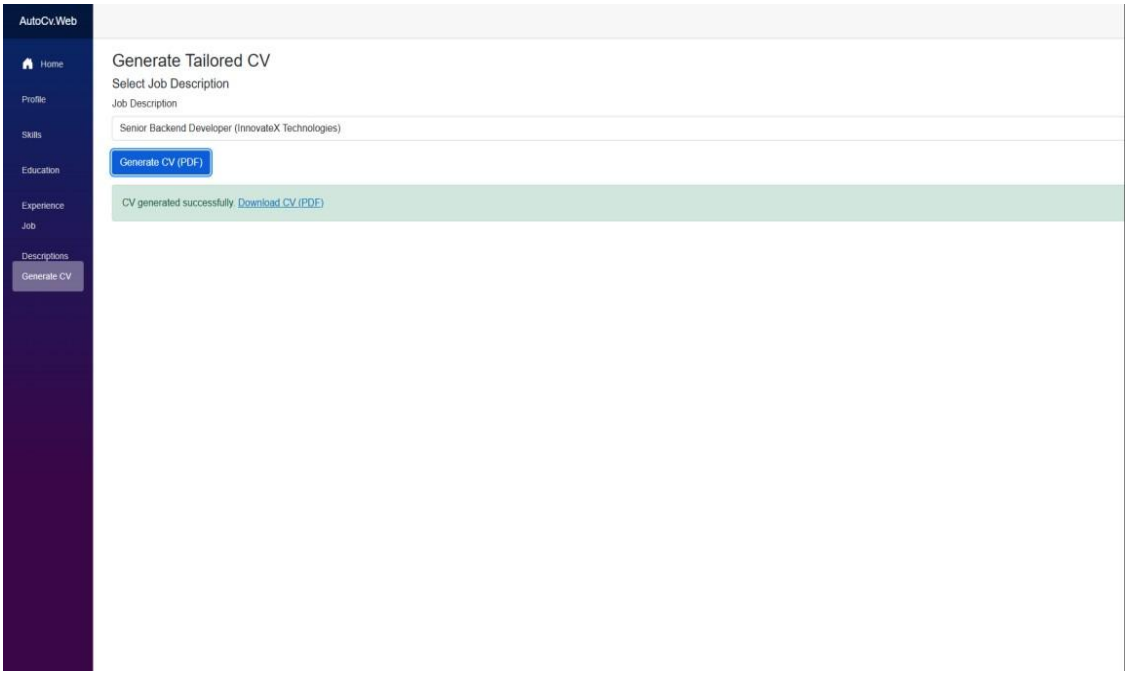

Figure 7: Generated CV PDF output proving final system integration

Both unit and integration testing cases are developed around real-life scenarios, ensuring the system behaves as expected under normal conditions. Edge cases are also considered, such as half-completed user profiles or job descriptions with uncommon structures. Such examinations can reveal potential problems and areas for improvement (Figure 8).

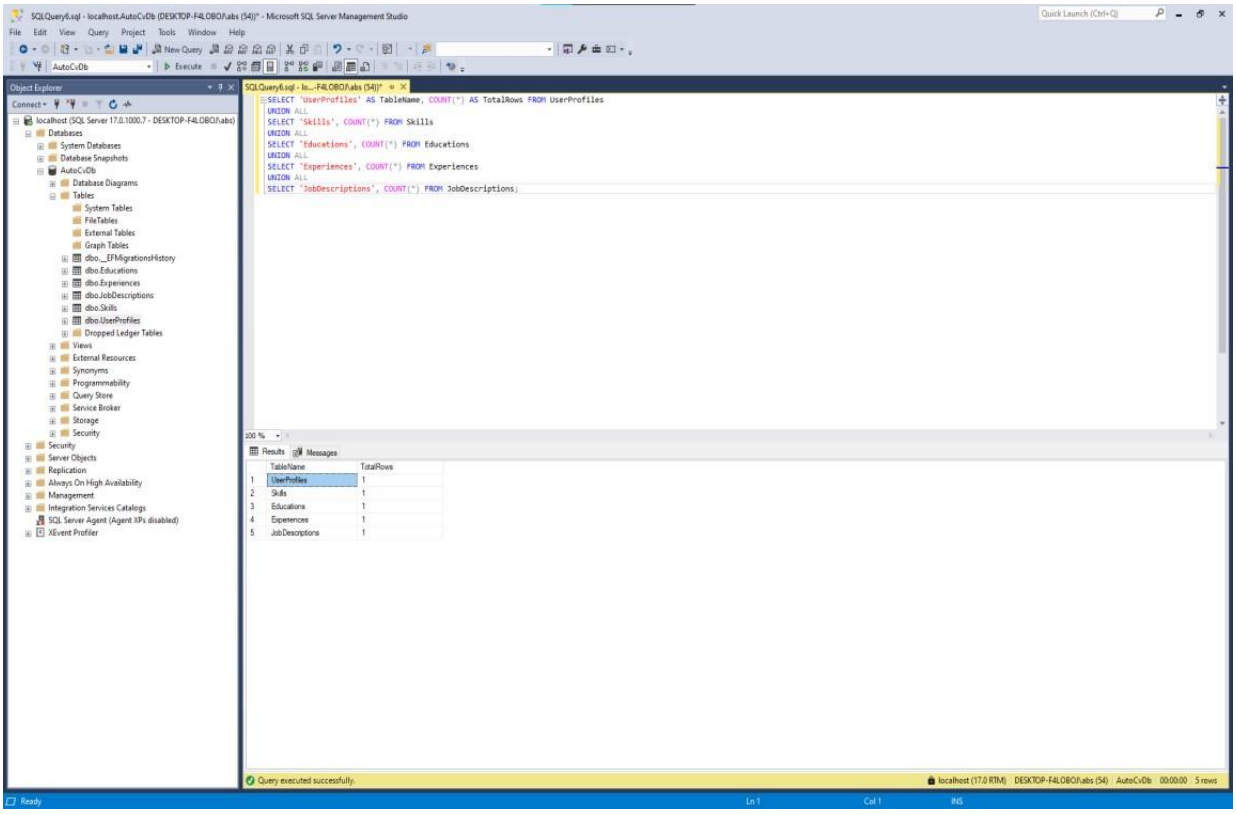

Figure 8: SQL server tables showing populated profile, skills, education, experience, and job descriptions records

Any problems noted during testing are reported, and the system is reworked iteratively to ensure all tests run successfully. This extensive testing is necessary to ensure that the Automated CV Customisation and Generation System is reliable, capable of creating CVs that satisfy the user's needs and are compatible with the ATS.

5.2. Performance Evaluation

The system performance assessment is essential to ensuring that the system can meet the needs of real-world applications, particularly when it has a large job description or many users simultaneously. The system's evaluation is based on key performance metrics, including response time, scalability, and resource consumption. These measures are used to evaluate the system's effectiveness in terms of speed, efficiency, and resource management (Figure 9). Response Time is an important metric for ensuring the system provides a good user experience. The time required by the system to process users' input, e.g., job descriptions or user profiles, and produce a tailor-made CV should be minimal. Performance benchmarks are set to evaluate key activities within the system, such as job description parsing, profile matching, and CV generation [26]. The response time is determined under various conditions, including different input sizes and complexities. For example, the system must be able to process and generate a CV in 10 seconds for a standard user profile and employment description. Such a requirement is critical to ensuring that job seekers can efficiently generate CVs when applying to various job postings and reduce waiting time in the application process. Another critical aspect of the evaluation is its scalability. The system should also be able to support an increasing number of simultaneous users without any serious performance impairment. Stress testing simulates high-traffic conditions in which several users simultaneously post job descriptions and generate CVs. The system's scalability is determined by testing its performance under heavy load [3].

Bottlenecks, such as low database query rates or document generation delays, are also detected and addressed to ensure the system can accommodate a large proportion of concurrent users. The findings of these scalability tests are used to optimise the system's architecture, ensuring it remains performant as demand increases. Resource Usage is a vital parameter for assessing the system's efficiency. During testing, the system's resource consumption, such as CPU and memory, is monitored to assess whether it remains efficient under load. The system is designed to run on a range of hardware, including lower-end systems, so it remains responsive even with limited computational power. Resource usage is tracked during intensive processing, such as the creation of large CV documents, to identify inefficiencies. The outcome of these tests also guarantees that the system will be optimised to perform and can be used with numerous types of devices, both high-end machines and low-end computers or mobile devices. All these performance metrics will make the Automated CV Customisation and Generation System capable of

providing a smooth, efficient experience for users, even under varying load conditions and when job descriptions and user profiles are diverse.

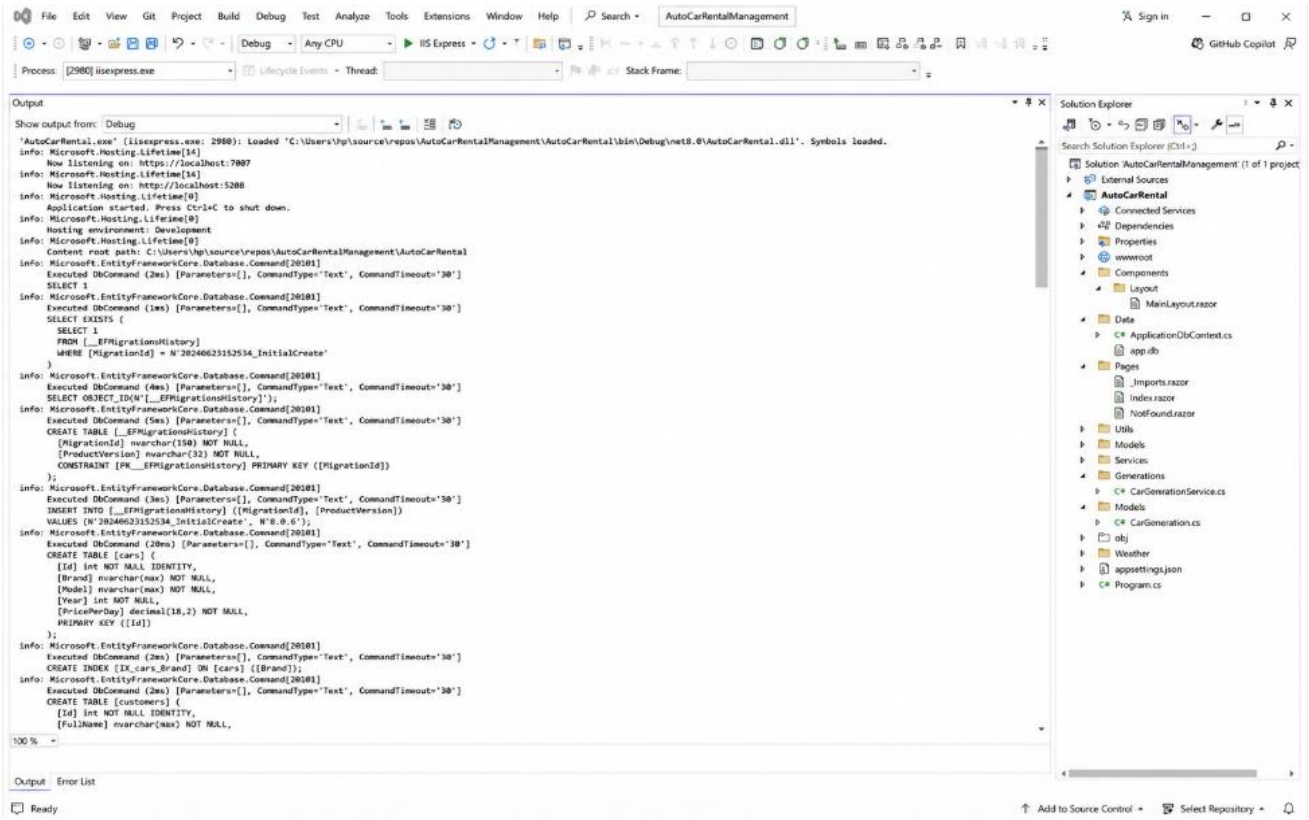

Figure 9: Visual Studio output log showing response time for CV generation (job parsing → Matching → pdf output)

5.3. Accuracy and Relevance

Two of the most significant criteria for evaluating the effectiveness of the Matching and Ranking Engine and the CV Generation Engine have been accuracy and relevance. The quality of the CV depends directly on how well the system matches the user's qualifications to the most valuable requirements of a job description. Semantic Accuracy is a measure of how accurately the system correlates the user's qualifications with the job description. The Matching and Ranking Engine compares the user profile, that is, skills, work experience, and education, to the job requirements that have been extracted from the job description. This matching process is checked for accuracy against system-generated matches and manually curated matches. As a reference, a dataset is a set of job descriptions and user profiles related to them. The system generates the CVs, and human experts review them to ensure the most relevant qualifications are identified and ranked correctly. The system's performance is measured using precision and recall. Precision is the extent to which the system-identified qualifications are actually applicable to the job. In contrast, recall is the extent to which the system identifies the job description qualifications.

The response would be a high-precision, high-recall score to ensure that the system produces a very relevant CV. Generating a CV is relevant to the job description, as the content is compared against it. The CV is expected to highlight the most valued skills, qualifications, and experience, and to organise the information in a way that demonstrates the priorities outlined in the job description. Human evaluators review the CVs to determine whether the system emphasises the most critical qualifications. To illustrate, the CV to apply to a job as a software developer will need to focus on technical knowledge such as programming languages, software frameworks, and tools, and the CV must be designed in such a manner that it is easy to evaluate the applicant for the position by the hiring manager or an automated system. The use of the CV is also determined by how well it fits the user profile and the recruiters' expectations. By comparing system-generated CVs with hand-generated ones and evaluating the semantic accuracy of the matching algorithm, the findings will provide a useful basis for fine-tuning the system to produce CVs that are not only highly relevant but also accurate.

5.4. User Evaluation

The important feature of the Automated CV Customisation and Generation System is user evaluation, as it determines the practical effectiveness of the new system. The two main aspects evaluated in this evaluation are the readability of CVs and their compatibility with ATS systems. CV Readability is tested using a set of test users who review system-generated CVs to assess their readability and understanding of the information. The questions for users include: does the CV effectively communicate the user's qualifications, is it easy to read, and does it present the most relevant skills and experience? The survey and interview, as the basis for this feedback, will enable a qualitative evaluation of the structure and information presented in the CV. Moreover, users are asked to estimate their overall satisfaction with the CV, assuming it accurately represents their professional profile. This is aimed at making the CV not only compatible with the ATS but also attractive and readable to human recruiters (Figure 10).

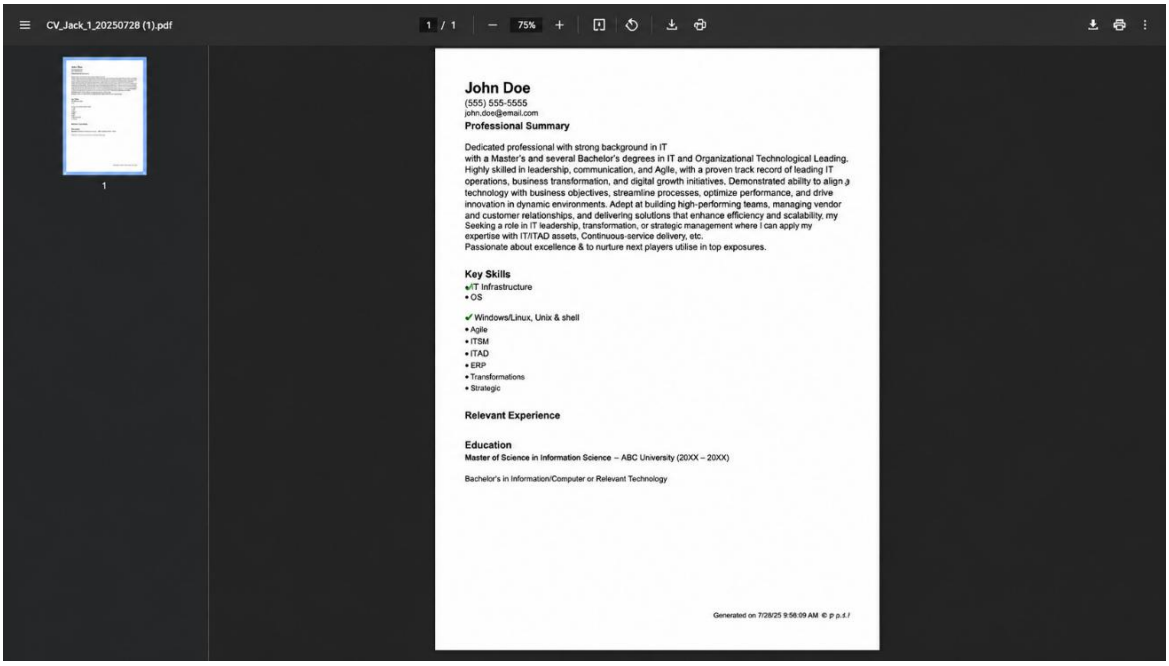

Figure 10: Example user-facing CV showing readable formatting, structured sections, and professionally styled content

ATS Compatibility is assessed by comparing the CVs generated by the system with various other real-world ATS tools, including Jobscan, which companies use to filter resumes. The tools scan and analyse CVs, assessing them based on factors such as keyword use, structure, and formatting. Users are requested to post their generated CVs in these ATS tools, and the performance of the CVs in the system is analysed to assess the system's effectiveness. The major criteria are the success of the CV's commitment to the parsing process and adherence to the formatting criteria (the use of standard headings and fonts, the emphasis on the right keywords, etc.). This analysis is done to ensure that the CVs generated by the system are ATS-optimised, increasing the likelihood that the applicant passes automated screening. The outcomes of the user test are useful for the system's practical efficiency, as they ensure that CVs can be read not only by humans but also by ATS systems, which is critical for job seekers who want to score the interview.

The Assessment of the Automated CV Customisation and Generation System will provide the necessary information on its functional efficiency, operational performance, and user satisfaction. Functional testing is important to ensure that every unit of the system functions as expected. In contrast, performance testing is important to ensure that the system remains responsive and scales even under heavy load [21]. Accuracy and relevance tests will ensure that the system accurately matches user profiles to job descriptions and produces relevant, ATS-compliant CVs. Lastly, user assessment checks that the system is practical, producing readable, well-structured CVs that satisfy ATS requirements. The assessment outcomes indicate that the Automated CV Customisation and Generation System is an efficient tool to improve job application efficiency, especially by automating CV customisation and optimising generated CVs for compatibility with ATS systems. Additional enhancements and development will focus on improving the semantic accuracy of the matching algorithm, fine-tuning the user interface to provide a more enjoyable experience, and enabling the system to handle a broader range of job descriptions and user profiles. The system has high potential to help job seekers effectively customise their CVs and increase their chances of getting interviews.

6. Discussion

The assessment of the Automated CV Customisation and Generation System has provided essential information on its general functionality, performance, and opportunities for further evolution. Functional testing, performance evaluation, accuracy and relevance tests, and user evaluations yield results that not only highlight the system's strengths but also identify areas that still need improvement. The findings form part of the evaluation of how the system works in the real world and its effectiveness in addressing the needs of both job seekers and recruiters. The important findings of the evaluation process are discussed below.

6.1. Functional Testing Results

They conducted functional testing to ensure the system's core modules worked as intended, whether in isolation or as part of an integrated workflow. Each module, such as the User Profile System, Job Description Analyser, Matching and Ranking Engine, CV Generation Engine, and ATS Optimisation Layer, had unit tests that ensured each module performed as intended [10]. An example is the User Profile System, which was tested for its ability to store user data, including skills, experience, and certifications, and was found to be precise and accurate. In the same manner, the Job Description Analyser was tested to assess its ability to handle job descriptions, extract relevant skills, and identify required qualifications. Integration tests were also conducted to determine the relative functionality of the modules. Integration testing focused on ensuring that information flowed properly between the Blazor user interface, the backend systems (including the NLP pipeline), and the document generation components. This test proved that the Matching and Ranking Engine and the CV Generation Engine worked in harmony, with ranked qualifications transferred from the engine to the CV generation section. The ATS Optimisation Layer was also tested to be working as expected, ensuring the generated CV is in the correct format and that keywords are positioned correctly as required by ATS systems. But there were edge cases in which the system would slow down, e.g., when user profiles were incomplete or job descriptions were overly complex. Such delays were not significant, but they suggest there is room for further improvement in the process for managing non-standard data input. These edge cases will require updates in the future to make the user’s experience smoother and more efficient across a variety of situations.

6.1.1. Results of Performance Evaluation

The performance testing evaluated the system's response time, scalability, and resource consumption, which are important for ensuring the system can deliver under real-world usage conditions. The three key tasks in the system were to set benchmarks for response time, including job description parsing, profile matching, and CV generation. The system could also meet the performance standard of producing a CV in less than 10 seconds for any normal job description and user profile, ensuring that job seekers can optimise their resumes for job applications. However, performance degraded when multiple users attempted to generate CVs simultaneously, particularly with large, complex documents. The system did not cope with heavy traffic, and bottlenecks were found in database queries and document generation procedures [22]. This implies that the system can only support moderate concurrent use, but further adjustments are needed to scale it to support large numbers of users. Precisely, there is a need to enhance the backend architecture, including load balancing and query optimisation, to enable the system to expand effectively to meet rising demand. The resource usage tests indicated that the system's CPU and memory usage remained within an acceptable range, even when handling large CV documents or performing multiple activities simultaneously. Nevertheless, it is still possible to optimise the system to run on a less powerful device, thereby enhancing the robustness of more resource-intensive undertakings, such as document production and NLP.

6.1.2. Accuracy and Relevance Results

Precision and Recall were used to measure the utility and validity of the system with respect to the Matching and Ranking Engine, which determines the system's ability to accurately match the user's qualifications to the job description. The system scored high on precision, meaning most of the qualifications it detected are actually pertinent to the job description. This shows that the system is efficient at identifying the most relevant qualifications. Nevertheless, the final recall score was lower, indicating that the system identified a high number of relevant qualifications but did not consider all possible ones that would have improved the CV's relevance [27]. This implies that there is still room for improvement in how the system recognises the less apparent yet relevant qualifications. An area for future development is improving the semantic matching algorithm to increase recall by preserving more relevant qualifications, including those that may not be stated in the job description. The relevance of generated CVs was measured against manually generated CVs for the same job descriptions. The created CVs reflected the most significant competencies and experiences, especially in the case of technical competencies and authorisation. Evaluators' feedback, however, revealed that the system could be better at handling soft skills and personal achievement, which, although also highly important to the recruitment process, are not always clearly stated in job descriptions. It may be possible to make the CVs even more complete and representative of the applicant's full set of skills by improving the system to identify and prioritise these attributes.

6.1.3. User Evaluation Results

The user assessment provided insight into the effectiveness of the Automated CV customisation and Generation system in general, as perceived by job seekers who utilise it. The test users reported that the CVs created by the system were straightforward, organised, and easy to understand. The Blazor-based user interface received a warm reception for its simplicity and ease of use. Users of the tests liked that they could quickly enter their profile information, post job descriptions, and receive tailored CVs; however, the ATS compatibility testing identified areas for improvement. Although the system succeeded in passing the majority of ATS tests, there were also edge cases in which non-standard CV formats or sophisticated keyword searches led to parsing errors (SSR G International Journal of Computer Science & Engineering. This highlights the need for further improvement in handling different CV structures and ensuring that all keywords are adequately encoded for processing by ATS. Though, as a rule, the system succeeded in optimising CVs for ATS, slight adjustments to the ATS Optimisation Layer could prove useful when dealing with complex job descriptions. All in all, user feedback supported the system's intended objectives: to offer a fast, effective, and automated tool for customising CVs. Nevertheless, the feedback also identified areas where the system could be further optimised.

6.2. Implications

The implications of the evaluation outcomes for job applicants, recruiters, and the recruitment industry as a whole are also significant. The possible implications of the system's key findings are discussed below.

6.2.1. Consequences of Job Applicants

The Automated CV Customisation and Generation System offers several advantages for job applicants. To begin with, the system enables applicants to quickly customise their CVs to meet the requirements of each job post. This automation saves time and effort that would otherwise be spent customising resumes for each application, particularly for applicants who submit applications to multiple job openings. The ATS optimisation ensures that CVs are created in line with the needs of automated recruitment systems, which are becoming increasingly widespread across most industries. The system will increase the likelihood that job applicants are shortlisted for interviews by ensuring their CVs pass through an ATS filter [6]. This is especially relevant in sectors where ATS-based recruitment is the norm, and failing to meet ATS requirements may be a big step towards a candidate being ignored. The system's semantic matching capability ensures that the produced CVs accurately reflect the applicant's most relevant skills, qualifications, and experience. This enhances the application's quality, and the applicant is likely to be regarded as a strong candidate for the position. Another more important advantage is the real-time preview of the CV, which enables the applicant to see how their CV will actually appear after it is tailored to a particular job, giving them the certainty that they are putting up the best possible foot forward. Nevertheless, applicants may still face certain difficulties with the system regarding soft skills and personal success, which the current version does not always consider, as well as technical skills. Further advances in this regard would provide a more comprehensive picture of a candidate's qualifications.

6.2.2. Implications for Recruiters

For recruiters, the Automated CV Customisation and Generation System is highly beneficial for both efficiency and consistency. Recruiters can also save time and effort by reviewing applications by ensuring that CVs are ATS-compatible and consistently formatted. The system will also help automate the rather tedious process of formatting CVs to comply with the requirements of ATS systems, without requiring any manual changes. In addition, the semantic matching feature ensures that the CVs prioritise the most relevant skills and qualifications for a particular job. This enables recruiters to quickly test candidates and determine the skills and experience needed to fill the job [1]. The reduced time spent on manual resume screening by recruiters allows them to focus more on cultural fit and soft skills evaluation, which an automated system cannot effectively assess, but that still plays a crucial role in the hiring process. Nonetheless, recruiters might continue to discover that the system can sometimes fail to capture more refined qualifications or experience which are significant yet not explicitly mentioned in the job description. Recruiters may also be required to evaluate the candidate's cultural fit and personal attributes, which the system cannot fully represent. The next generation of the system can help enhance these aspects and transform it into a more comprehensive candidate evaluation instrument.

6.2.3. Employment Implications on the Recruitment Industry

On a broader level, the results indicate that automated tools for customising CVs can revolutionise the recruitment industry. With the increasing reliance of recruitment processes on ATS-mediated technologies, systems such as the Automated CV Customisation and Generation System can help bridge the divide between job applicants and recruiters. These systems can increase the effectiveness and efficiency of the recruitment process by ensuring CVs are ATS-compatible and tailored to the

job requirements. The system can also democratise the job application process, enabling job seekers, particularly those from underrepresented groups or disadvantaged backgrounds, to optimise their CVs and compete more effectively in the job market [3]. The system also equalises the playing field for applicants by eliminating part of the labour required to customise the CV (application), making it easier to customise the application and increasing the chance of success. Also, automated CV generation systems, such as this one, might lead to a more rapid hiring process, increased candidate-job fit, and subsequent hires of higher quality and more satisfied employers. It can also enhance diversity in companies by ensuring that everyone seeking a position has equal chances to demonstrate their qualifications.

6.3. Limitations

Although the Automated CV Customisation and Generation System has proven itself, several limitations should be noted.

6.3.1. System Limitations

The fact that the system addresses soft skills and personal accomplishments is one of its primary weaknesses, as it cannot always identify them effectively. Most job descriptions ask job applicants to exhibit interpersonal skills, teamwork, or leadership. Still, these attributes may be challenging for a system when pure textual analysis is used to match them [8]. The system's semantic matching is effective for technical skills but may be deficient in more subjective dimensions. Another weakness is that the system cannot handle highly technical job descriptions in specialised fields like medicine, law, or other technical fields. Although the system works well with general job descriptions, it can struggle with industry-specific jargon or highly specialised qualifications common to these roles. These roles would require customising the system to improve their respective accuracy. Lastly, there is also the issue of scalability. Although the system is effective in moderate traffic, it might slow to the point of congestion when user loads are high, especially during document generation [6]. Such bottlenecks can delay CV production and reduce the system's overall efficiency when demand is at full capacity.

6.3.2. User Limitations

On the user side, there is still a possibility that the system must be manually operated to ensure that the generated CV accurately reflects the individual's qualifications. Although the system can automatically handle most of the CV customisation process, the final document may require the user to verify or modify it to suit their needs. Moreover, some users may also find the user interface overwhelming, particularly users with scant experience with digital tools or employment application procedures.

6.4. Future Work

To overcome the weaknesses found during the assessment, further development of the Automated CV Customisation and Generation System should rely on the following areas of improvement:

6.4.1. Enhancing Soft Skills and Recognition of Personal Achievement

More sophisticated NLP methods, including named entity recognition (NER) and emotion analysis, can enhance the system's ability to detect and prioritise soft skills and personal achievements. Also, the system can better identify these nontechnical skills by adding these features, allowing users to manually add skills to their profiles or provide more information about each skill.

6.4.2. Improving Domain-Specific Job Description Processing

To be more precise in how specialised job descriptions are addressed, the system may, in the future, use domain-specific models or rely on custom training data to handle job descriptions in industries with niche vocabulary [4]. Transfer learning may be one of the techniques used to adapt an existing model to a particular field.

6.4.3. System Performance and Scalability Optimisation

The system will also require enhancement to meet the demand of large numbers of simultaneous users. It will also be necessary to optimise database queries, load balance, and cache frequently used data to ensure the system remains responsive even during peak times [3]. The document generation and storage cloud-based solutions might also enhance performance and scalability.

6.4.4. Improving User Experiences

More refinements of the user interface might be added to enhance the ease of use, especially for people who are not conversant with modern web applications. The detailed instructions, the less detailed design, and the ability to customise the CV templates more widely would improve the overall user experience.

7. Conclusion

The Automated CV Customisation and Generation System has demonstrated significant potential to improve the job application process by automatically generating CVs and ensuring ATS compatibility. Although the system is good at producing high-quality CVs that match job descriptions, it struggles to ensure uniformity in soft skills, handle complex job descriptions, and serve a large number of users. By overcoming these issues, the system can become an even more efficient tool for job seekers and employers to simplify the hiring process and improve the success of job applications. Future enhancements will focus on refining the semantic matching algorithm, implementing more specialised job descriptions in the system, and optimising performance and user experience. The Automated CV Customisation and Generation System is a brand-new tool designed to address the growing challenges job seekers face in the current job-recruiting environment. The demand for a solution that makes job applicants' curriculum vitae (CVs) ATS-friendly and tailored to a specific job description has become increasingly important as recruiting processes evolve and applicant tracking systems (ATS) are used to sort job applications. The purpose of this article was to design, create, and test a web-based system that incorporates Natural Language Processing (NLP) and Machine Learning (ML) technologies to automate the process of customising a curriculum vitae (CV). The purpose of this study was to construct a system that would receive job descriptions, check them against user profiles, and generate individualised curriculum vitae that would satisfy both the user and the applicant tracking system (ATS). Several technologies, such as the .NET ecosystem (ASP.NET Core, ML.NET, and ONNX Runtime), have been utilised in the construction of the system. Additionally, it features advanced natural language processing capabilities that semantically align job descriptions and user profiles. In addition, it uses ATS optimisation capabilities to ensure that the generated CVs adhere to ATS standard formatting requirements, including keyword density, heading structure, and document structure.

Acknowledgement: The author sincerely acknowledges the academic support, research facilities, and institutional resources provided by the University of the West of Scotland, which significantly contributed to the successful completion of this research work.

Data Availability Statement: The data supporting this study relate to an intelligent NLP-based web application for automated CV customisation and Applicant Tracking System (ATS) optimisation. The research materials and supporting datasets are available from the corresponding author upon reasonable request, subject to applicable institutional and ethical requirements.

Funding Statement: The author confirms that this research was conducted without financial support from any public, private, commercial, or not-for-profit funding agency.

Conflicts of Interest Statement: The author declares that there are no financial, professional, academic, or personal conflicts of interest that could have influenced the design, implementation, analysis, or reporting of this research. All referenced literature and resources have been appropriately cited and acknowledged.

Ethics and Consent Statement: The author affirms that the study was carried out in accordance with accepted ethical principles and institutional guidelines.

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