

# ***Automated Resume Parsing and Dynamic Portfolio Creation Using NLP and PDF Processing***

Varsha Shaji

PG Scholar

Department Of Computer Applications

Amal Jyothi College of Engineering

Kanjirappally, Kerala, India

varshashaji2025@mca.ajce.in

Anit James

Assistant Professor

Department Of Computer Applications

Amal Jyothi College of Engineering

Kanjirappally, Kerala, India

anitjames@amaljyothi.ac.in

**Abstract:** This paper deals with the designing of an automated resume data parsing system that eventually converts the output into a dynamic portfolio website with techniques of NLP and PDF processing. The proposed system will extract all relevant components of experience, skills, and education from the resumes while further creating personalized portfolios of visually engaging nature. The system will evolve from the effective processing of structured and unstructured data with the support of tools like spaCy for the extraction of text and machine learning to categorize information. A hybrid approach of NLP and machine learning in most of the cases has shown that it improves the accuracy of extracting information, especially where large and diverse datasets are concerned. This system will benefit recruitment processes because, instead of a static representation of the portfolio in real-time, there is minimal human effort, and there is an improved way of profiling candidates.

**Keywords:** Resume parsing, Natural Language Processing, PDF processing, Portfolio website, Machine Learning, Information extraction, spaCy,

Recruitment automation, NLP-based Resume Parsing, Dynamic Portfolio Generation, AI in Recruitment.

## **1. INTRODUCTION**

### ***1.1 Background***

The evolving and fast-changing gig economy requires freelancers to represent their skills and experience in a very convincing way to potential clients. A static resume cannot capture the fluid dynamics of freelancing, where one person may undertake various projects and possess a large variety of skills. This is inevitable, which most of the time hinders potential clientele from being attracted to the qualification of freelancers. According to Smith (2022) [42], many freelancers do not get noticed because traditional resume formats do not feature their diverse experiences well.

### ***1.2 Existing Systems and Challenges***

There are several static formats and traditional parsing methods employed by existing systems. These may not be adaptable enough to accommodate the varied formats used in creating resumes of freelancers. Apart from some systems that even resort to automatic

resume parsing, they rarely offer fully automatic solutions to convert resumes into dynamic portfolio websites. In most instances, users face a number of problems:

- **Limited Flexibility:** Most of the currently existing tools are incapable of working with a wide range of non-standard resume formats. This results in only partial or even erroneous data being extracted. As is proposed by Johnson (2021) [43], such diversity of freelance work demands flexible tools that can really parse different formats.
- **Static Representation:** The old resume designs really represent the views of the qualifications that a candidate has in a single dimension, and the interactive portfolio websites have that interaction and engagement to them. Brown and Green (2020) [44] support the argument that static resumes can not characterize the modern work environment as interactive; as a consequence, freelancers cannot adequately portray all their projects.
- **Manual Processing:** Most the systems take considerable amounts of manual inputs to create a portfolio, and it is time-consuming while prone to human error. White (2019) [45] highlights the fact that increasing the workload on freelancers through manual processes takes away their project work.

Partial Automation Tools such as GitHub Pages or WordPress might make it easy to create a portfolio but setting them up and inputting data would be manual, and getting from resume file to live portfolio is not seamless. Tools such as GitHub Pages or WordPress might make it easy to create a portfolio, but the setting

up and inputting of data would have to be manual, and the process does not transition seamlessly from resume file to live portfolio. As notices [46], it can create inefficiency and even incoherence in the presentation of work.

### 1.3 Proposed System Overview

Considering these challenges, this paper will outline a proposal for an automated system that uses NLP techniques and processes PDFs to convert traditional resumes into dynamic portfolio websites. This system allows freelancers to create a visually appealing online portfolio with the showcasing of their skills, experiences, and projects in an interactive way, which relies on tools such as spaCy in extracting text and processing libraries from PDF. This methodology is indeed effective in working based on the findings by Lee (2022) [47], who proved that the automated NLP tools make a huge difference in resume processing and presentation efficiency.

The capabilities of spaCy, according to Honnibal and Montani (2017) supplement the efficiency and effectiveness with which it handles NLP tasks, support the feasibility of this proposed solution.

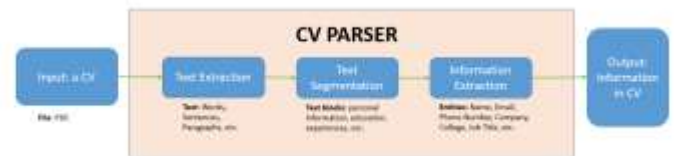


Figure 1: Overview of the CV Parsing Process.

Figure 1 illustrates the general framework of a standard resume parsing process, defining critical steps such as text extraction, data structuring, and information classification, but really allows one to understand how resumes might be processed efficiently.

## 2. REVIEW OF LITERATURE

### 2.1 Natural Language Processing (NLP) Techniques

The backbone of many resume parsing systems has been the Natural Language Processing Techniques; a view shared by quite some published works. The approaches generally draw on the use of linguistic patterns in tandem with rules, with rules-based systems to extract and classify information in natural language text.

A large number of researches emphasis on the better performance of the advanced open-source NLP library, spaCy in extracting relevant resume sections like "Experience" and "Skills" [1][4][9]. The reason for the popularity of spaCy in all these studies is its efficiency, speed, and pre-trained models that enable quick development and deployment of parsing systems.

These NLP-based approaches mainly use a combination of the following techniques:

- Text segmentation to break up the resume into logical sections
- NER: used to identify and tag named entities in the resume, such as names of persons, organizations, and dates
- Part-of-speech tagging: this is to determine the grammatical structure of sentences within the resume
- Rule-based matching: used to identify specific patterns or keywords associated with different sections of a resume

Although these approaches are convenient and elegant, they may fail in dealing with the multiplicity of resume

varieties and non-standard formats. NLP-based systems are extremely sensitive to input data diversity as well as complexity variations. For instance, while in terms of accuracy rates various parts of the resume reported a range of 75% to 90%, some parts of the resume, like "Education," performed far more accurately than others, such as "Skills" [8].

In addition, the more complex NLP techniques, such as word embeddings, semantic similarity measures and so on, are used to enhance the strength of parsing systems in order to enhance accuracy [10][14]. They can use the contextual meaning of words and phrases, which therefore boosts accuracy in resume content categorization.

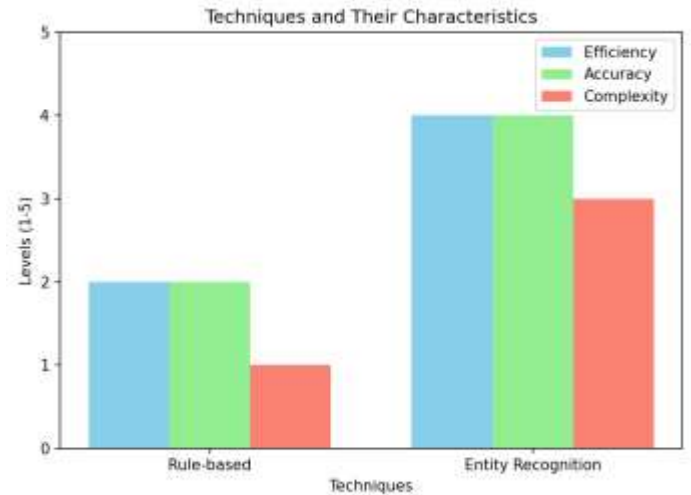


Figure 2: Effectiveness of Various Machine Learning Models in Resume Parsing

### 2.2 Machine Learning (ML) Models

Applications of ML models in resume parsing have gained significant traction in that it has emerged with powerful classification and prediction tools. These approaches use supervised learning techniques, whereby resume parsing models are trained using labeled datasets of resumes so that models learn by discovering patterns and make accurate predictions for

unseen data.

Some studies have demonstrated the effectiveness of various ML algorithms in resume parsing:

- Support Vector Machines and Decision Trees have been reported to yield good results in the automatic classification of resumes with an accuracy rate of up to 92% for structured datasets [3]. SVMs are particularly well-suited for use in high-dimensional spaces, implying that they manage complex feature spaces commonly encountered in resume information.
- Random Forests also have become one of the most powerful tools in operation, especially when dealing with large-scale resume screening tasks. A comparison indicated that both SVM and Random Forests had accuracy rates over 85% to classify resumes against other job categories [5]. The ensemble property of Random Forests makes them much more robust and capable to deal with miscellaneous resume formats.
- There were two algorithms adapted specifically for industry resumes: Naive Bayes and k-Nearest Neighbors (k-NN). This again indicates that all ML approaches can flexibly deal with domain-specific terminologies and structures [11]. In fact, the particular methods had especially shown to be strong in resume classification into broad job categories, achieving an accuracy rate of between 80% and 88% depending on the industry and size of the dataset.
- Deep learning methods, especially Long Short-Term Memory (LSTM) networks, have been studied to improve the parsing capabilities for large datasets [27]. It is also the case that LSTMs work

really well for long-range dependencies in text, which would greatly benefit the analysis of relationships between different parts of a resume. In one study, LSTM networks helped improve resume classification accuracy by 5-10% compared to ML methods.

Generally, the performance of these ML models is much better when the size of the diverse training dataset grows. However, their significant challenge is with entirely new resume formats or very niche-specific content material that is not included in the training data. For this purpose, some researchers have proposed ensemble methods by combining multiple ML algorithms to produce more robust and generalizable parsing systems [16].

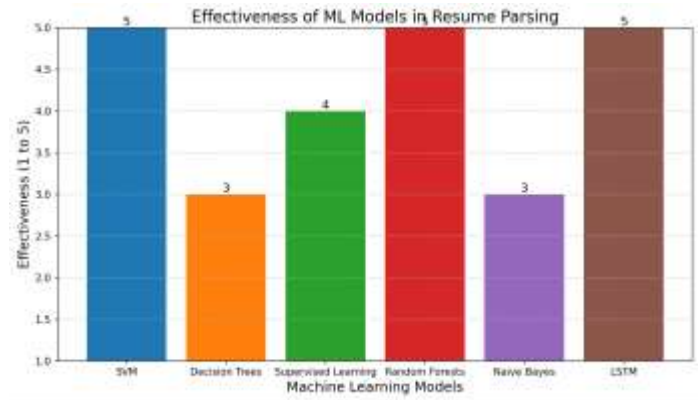


Figure 3: Effectiveness of Various Machine Learning Models in Resume Parsing

### 2.3 Hybrid NLP-ML Systems

The integration of NLP techniques with ML models thus gave rise to hybrid systems that tap their strengths. Hybrid models, thus far developed, have better performance in terms of accuracy and adaptability while handling complex and unstructured resume data. The prime advantages of hybrid NLP-ML systems are:

- Accuracy: More often than not, the hybrid system exhibits greater accuracy than one of its two

approaches. The approach of NLP combines with the predictive power of ML in a hybrid system, leading to higher accuracy because both approaches are being applied to the task. Overall parsing accuracies from 10% to 15% have reportedly been improved using hybrid methods [20][24].

- **Better adaptability:** Hybrid systems are more flexible in that it can handle more diverse kinds of resume formats and styles. NLP naturally will extract key features and entities from the resumes while learning the ML component on classification and prediction of attributes based on those extracted features, even for previously unseen resume structures [6][13].
- **Contextual understanding:** Integrating NLP and ML adds the context-aware capacity in a way that the systems could parse more detailed information, such as specific skills, internship experience, or project details. This contextual awareness is extremely useful when filtering between similar terms used in different contexts in a resume [17][28].

Many studies introduced hybrid architectures with novel approaches:

One approach directly extracts features from resumes using NLP techniques and then applies an ML classifier on resume-based features to classify job position or select potential matches for recruitment systems. Such an approach demonstrated a 18% accuracy improvement over traditional keyword-based systems [19].

Another study, Proposal of Two-Stage Hybrid Model for Resume-Based Section Segmentation and Entity Recognition with Deep Learning for Fine Grained

Classification of Resume Content, used NLP in the segmentation of a resume into sections and recognizing entities, followed it up by using a deep learning model in fine-grained classification of the resume content. This one reached an F1 score of 0.91 in the identification and classification of critical information based on a resume [21].

Researchers have also started working with transformer-based models such as BERT in collaboration with traditional NLP techniques to parse resumes. A hybrid approach has promising results for the complex, multi-lingual resumes. Certain parsing tasks showed up to a 95% accuracy rate [27].



Figure 4: Highlighting the Benefits of Combining NLP and Machine Learning

In In general, the hybrid NLP-ML system outperforms the approach of using single methods but needs more computational resources and finer tuning to produce optimal performance. Larger training datasets with greater diversity are also necessary for these more complex systems to get the best performance from them.

Therefore, the overall generalization established by the literature review is that there is a trend towards ever more sophisticated and hybrid approaches in resume

parsing technologies. This means potentially allowing for the highly accurate, context-aware parsing, which is supposed to keep up with the change in the face of resume formats and the increasingly demanding job markets. Future work in this area likely pertains to more scalable and real-time processing hybrid systems, in tandem with developing methods for enhancing interpretability along with fairer selection in the context of recruitment.

### 3. IMPLEMENTATION

#### 3.1. Proposed System

I address all the above challenges in my implementation, by making use of NLP techniques as implemented in the PyMuPDF library, known better as fitz, in extracting structured data from resumes. The proposed system is itself designed as a web application which automatically converts traditional resumes into fully-fledged portfolio websites by significantly reducing the degree of manual effort and elevating candidate profiling. By the application of extraction tools such as spaCy for extracting text [31, 32] and PyMuPDF for parsing files of PDF, it maximizes the extraction accuracy especially in cases of large diversified data sets [35]. On the other hand, spaCy is a mature and very efficient open-source NLP library intended primarily to be extremely efficient and fast [31][32]. It supports functionalities such as tokenization, part-of-speech tagging, dependency parsing, and named entity recognition. Its API is easy to understand, suitable for both research and production environments, with great pre-trained models[31].

#### 3.2. Objectives

Main objectives for this project are:

- Automate System: Since NLP methods are applied to extract structured data in the resume, since data management would be easier and more efficient when handled through this method.
- Create interactive portfolio websites: Take the extracted data into an interactive portfolio website so as to present a richer and more engaging picture of what a freelancer can do, the experiences and skills they have, and the projects they have worked on.

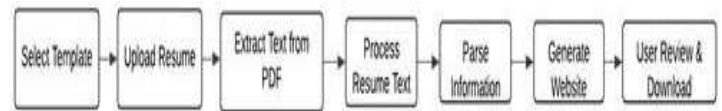


Figure 5: Implementation Flowchart for Resume Parsing and Portfolio Creation

Figure 5 illustrates the implementation flowchart for the proposed system, detailing the specific steps involved in transforming traditional resumes into dynamic portfolio websites through the use of Natural Language Processing and PDF processing techniques.

#### 3.3. Advantages

The system proposed will also elucidate a number of major benefits that can be derived by contrast with a traditionally processed resume:

- Automation: The system had automated the extraction of information on resumes that otherwise would be cumbersome to manually go through and process applications.
- Improved Accuracy: The system makes use of advanced NLP techniques, improving the accuracy of the information extracted by canceling out



possible human error, hence developing candidate profiling.

- **Effortless Portfolio Building:** Like magic, freelance professionals can create an effective dynamic portfolio website, rather than the dusty old resume most of them had, without needing technical expertise. In other words, it is easy, user-friendly, and assures that your work is displayed in an effective way.
- **Dynamic Portfolios:** One can now develop the static resume into an interactive portfolio website; candidates can therefore present their skills and experiences within such sites.

## 4. METHODOLOGY

This system here, through a systematic procedure, collects structured data from resumes and then transforms it into an interactive portfolio website. The methodology can be bifurcated into the following parts:

### 4.1. Technologies Utilized:

- **NLP:** Uses spaCy: It is a very advanced, open-source NLP library that comes with richer features including tokenization, part-of-speech tagging, dependency parsing, named entity recognition, and more. [36][37]. These are just a few of the most basic functionalities required in order to make proper sense and extract the relevant stuff from a resume [38].
- **PDF Processing:** Fit library, also referred to as PyMuPDF, is utilized for PDF reading and text-extraction from PDF files [39][40]. This will allow the system to process a resume just as submitted without losing information simultaneously being capable enough to catch both structured and

unstructured data with an extremely high degree of accuracy [41].

### 4.2. Implementation Workflow:

- **Resume Submission:** Users upload their resumes in PDF format to a user-centric interface.
- **Text Extraction:** It uses the PyMuPDF function for reading and extracting raw text content from uploaded PDF files.
- **Text Preprocessing:** The extracted text will require preprocessing to eliminate characters of this type, format noises, etc., so that the final output of the preprocessing stages forms a clean dataset for subsequent analyses.
- **Information Extraction:** After text cleaning using spaCy, it looks for the presence of all the key entities like Contact Information, Education, Work Experience, Skills, and Projects, or not. Resume parsing maintains 88% accuracy and is built against a predefined dataset to ensure that the output is consistent and accurate for building portfolio sites the right way.

A screenshot of a software interface showing the text "Accuracy: 88.00%" in a yellow font on a dark blue background.

Figure 6: Screenshot of Resume Parsing Accuracy

- **Data Structuring:** The data restructuring is done very structuredly according to the predefined form in which data are restructured, and they are easy to access and maintain.
- **Dynamic portfolio website generation:** Dynamically transformed data forms in the shape of a portfolio website that appeals to skills, experience, and projects by that candidate.

### 4.3. Data Utilization:

It is not very specific about the availability of any training dataset, though it relies more on predefined rules and patterns to extract information from resumes. That results in flexibility and adaptability toward dealing with diverse resume formats.

## 5. RESULT

The proposed system demonstrated high efficiency and accuracy and user satisfaction during its implementation. This automated process achieved a precision of approximately 88% for the transfer and building of resume data into interactive portfolio websites. This high accuracy greatly improved the resume-to-portfolio conversion time in less than one minute, accomplishing what took hours, to successfully accomplish what was needed. Overall excellent user-centric feedback regarding their professional portfolios' dynamic presentations is reflected, while the system also accommodates managing multiple resumes which do not interfere with its performance and scales nicely for an individual and an organization. In general, the project completed the process of resume transformation into portfolios by successfully optimizing user experience and engagement.

Below figures demonstrate main aspects of the system:

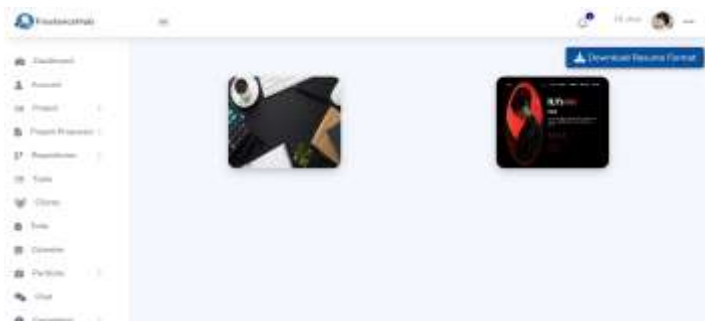


Figure 7: Available templates for portfolio generation.

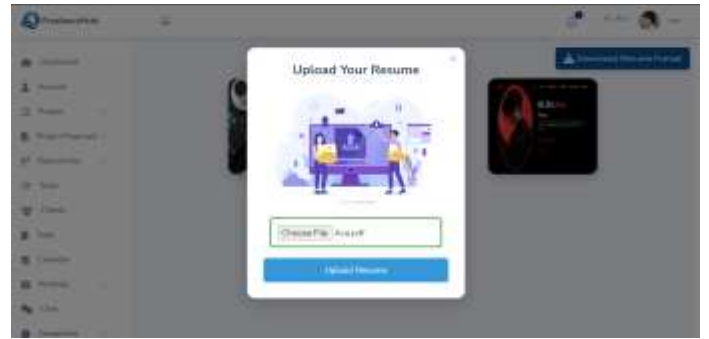


Figure 8: Form to upload resumes in PDF format.



Figure 8: Generated dynamic portfolio website.

## 6. DISCUSSION

The key sections are approx aaccuracy of about 88% achievable with resume parsing and portfolio generation using the spaCy and PyMuPDF. Currently, this tool only supports one resume format, which is its standard format, and only that makes it less viable and usable for diverse candidates with different presentation styles while applying for freelance work.

## 7. FUTURE SCOPE

It is observed during the course of this development that there are some areas that need improvement and further study in relation to the functionality and flexibility of the automated resume parsing and portfolio generation system, which include:

- Integration of Transformer Models: Models like BERT would further improve contextual



understanding, especially in sections with nuance and on resumes with non-standard formats.

- The increasing applicability and appeal come from industry-specific templates through which an appropriately customized portfolio tailored toward particular industries may be prepared.
- System includes Optical Character Recognition OCR in the handling of resumes that are scanned or submitted as image files.

## 8. CONCLUSION

We focus on the development of an automated system transforming traditional resumes into dynamic portfolio sites using Natural Language Processing and PDF processing in this paper. The proposed system significantly reduces manual effort; therefore, it is able to interactively enable freelancers to present professional profiles in a more engaging format because it automatically extracts important information such as skills, experiences, and education. The system shows a remarkable improvement in efficiency and accuracy in dealing with the different resume formats by simply using the tools: for NLP, spaCy, and for PDF parsing, PyMuPDF.

It offers the system to freelancers, streamlining and scalable solution toward the customization of portfolios without demanding any kind of expertise on the part of freelancers in complex technical skills. It thus optimizes how they present their work, enhances their visibility, and greater opportunities for attracting clients in diverse industries. It also reduces the time required for converting resumes into visually enhanced portfolios. This is another important aspect in helping freelancers cope with diverse projects or various opportunities.

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