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Personality Prediction CV Analysis using NLP and Machine Learning

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ABSTRACT

Traditional hiring processes are often hindered by the manual review of resumes, a method that is time-consuming, resource-intensive, and prone to subjectivity. To address these inefficiencies, we have developed an automated web application that enhances candidate evaluation by analyzing both their CV and their personality.

The system employs a structured quiz based on the established Big Five personality model to generate a comprehensive personality profile. Simultaneously, it uses Natural Language Processing (NLP) techniques and NLTK libraries to parse, process, and categorize the content of a candidate's CV. A machine learning algorithm (Logistic Regression) then integrates these two data streams to support unbiased and data-driven hiring decisions. The results are further illuminated through intuitive graphs, providing clear visual aids for assessment.

Ultimately, this framework streamlines the recruitment workflow by automatically shortlisting the most suitable candidates, enabling recruiters to make faster and more reasonable decisions.

KEYWORDS : Prediction, Machine Learning, Natural Language Processing and Curriculum Vitae (CV).

INTRODUCTION

Effective communication plays a vital role in recruitment. The process typically begins with the job application, which includes personal details, work experience, and, most importantly, the candidate's CV. Since companies often receive thousands of applications for a single job opening, dedicated screening teams are assigned to filter and shortlist suitable candidates. However, manually reviewing every CV is highly challenging. As a result, many applicants are eliminated in the initial stages due to lack of relevance, poorly structured CVs, or insufficient skills. Selecting the right candidate is a complex task, as no applicant may be entirely perfect—some may lack technical expertise, while others may not exhibit the required personality traits.

In recruitment and selection, filtering applicants and identifying the most suitable individual is both critical and labor-intensive. Among the various evaluation factors, personality plays a particularly significant role in determining a candidate's suitability. However, making accurate judgments about an individual's

mindset is difficult. To address this challenge, we propose an approach that leverages Natural Language Processing (NLP) and Machine Learning (ML) to evaluate personality traits and assess both technical and interpersonal skills. Our system computes a personality score using a publicly available personality test dataset from Kaggle, while skill sets are analyzed through CV parsing.

Existing recruitment software often struggles with predicting personality scores effectively. Personality, though central to human behavior, evolves over time, making accurate assessment complex. In this study, we apply machine learning algorithms to develop models capable of addressing this limitation. Specifically, we aim to implement an NLP-based framework coupled with a Logistic Regression model to predict personality traits more reliably. The objectives of this work are:

1) To apply the Big Five Personality Trait model for personality prediction.
2) To enhance the performance of existing prediction models for greater reliability in real-world deployment.
3) To evaluate and test the proposed model to ensure its effectiveness in recruitment scenarios

LITERATURE REVIEW:

Logistic Regression is a widely used statistical method applied in predictive analytics and machine learning. It helps in modeling the relationship between a categorical dependent variable and one or more independent variables by estimating probabilities through a logistic regression equation. Unlike linear regression, which predicts continuous outcomes, Logistic Regression is particularly suited for classification problems where the target variable is categorical.

Historically, Logistic Regression was first employed in the biological sciences during the early twentieth century, after which its applications expanded into various fields, including the social sciences. Today, it is extensively used across domains such as healthcare, marketing, and natural language processing for tasks involving binary or multi-class classification.

For example, Logistic Regression can be applied to predict whether an email is spam (1) or not spam (0) (Saishruthi S., 2018). This makes it highly effective for solving real-world classification problems where the outcome must be assigned to discrete categories.

The figure below provides a schematic representation of how Logistic Regression functions in practice.

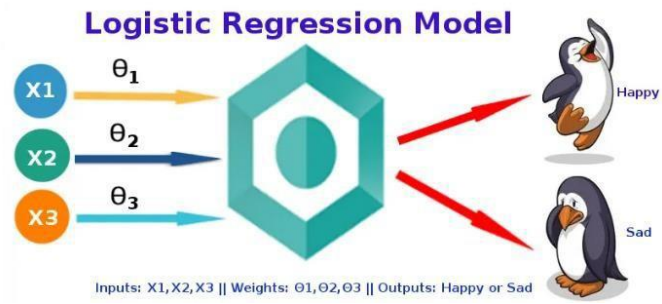


Figure: Logistic Regression model

EXISTING SYSTEM:

There are several existing systems and tools for CV analysis, ranging from simple keyword-based parser to sophisticated AI-driven platforms. Here are a few examples.

1. Applicant tracking system (ATS): ATS Software Is Commonly Used by Employers to Manage Job Applications and Analyze Resumes. These Systems Typically Scan Resumes for Keywords, Education, Experience, And Skills to Identify Qualified Candidates.
2. Natural language preprocessing (NLP) tools: NLP Algorithms Can Be Used to Analyze the Content of Cvs, Extracting Relevant Information Such as Skills, Experience, And Qualifications. These Tools Can Also Identify Sentiments, Writing Style, And Other Linguistic Features to Infer Personality Traits or Communication Skills.
3. Machine learning models: Some Companies Develop Custom Machine Learning Models to Analyze CVS. These Models Are Trained on Large Datasets of Resumes And Can Automatically Extract Information, Categorize Candidates, And Even Predict Candidate Suitability For Specific Roles Based On Historical Hiring Data.
4. Online cv parsing services: There Are Several Online Services That Offer CV Parsing Functionality, Allowing Users to Upload Resumes and Extract Structured Data Such as Education History, Work Experience, Skills, And Contact Information.
5. Open-source projects: Various Open-Source Projects and Libraries Provide Tools for CV Analysis. For Example, Spacy and NLTK Are Popular Python Libraries for Natural language processing tasks, which can be used to analyze CVs and extract relevant information.

6. Commercial solutions: Many companies offer commercial solutions for CV analysis, often incorporating advanced features such as sentiment analysis, personality prediction, and integration with other HR software systems.These systems and tools vary in complexity, functionality, and cost, so organizations should carefully evaluate their needs and requirements before selecting a CV analysis solution.

PROPOSED SYSTEM:

The Proposed System for Personality prediction through CV analysis:

1. Data gathering: We collect CVs from job applicants, which contain information about their education, work experience, skills, etc.
2. Feature Extraction: We extract relevant information from the CVs, such as the language used, job titles, and educational background.
3. Personality trait definition: We define the personality traits we want to predict, such as openness, conscientiousness, extraversion, agreeableness, and neuroticism.
4. Model training: We use machine learning techniques to train a model on a dataset that includes CVs and known personality traits. The model learns patterns in the data to predict personality traits based on the information provided in the CVs.
5. Model evaluation: We assess the performance of the model to ensure its accuracy in predicting personality traits.

This involves testing the model on new data to see how well it generalizes.

6. Deployment: Once we're confident in the model's performance, we deploy it so that itcan be used to predict personality traits for new CVs automatically.
7. Usage: Recruiters and hiring managers can input CVs into the system, and it will generate predictions for the candidate's personality traits. This information can help inform hiring decisions and identify candidates who are the best fit for a given role.

ADVANTAGES OF PROPOSED SYSTEM:

The proposed system for CV analysis offers several advantages:

1. Efficiency: By automating the analysis process, the system saves time and resources for recruiters, allowing them to focus on other aspects of the hiring process.
2. Scalability: The system can handle large volumes of CVs efficiently, making it suitable for organizations of all sizes and industries.
3. Consistency: The system ensures consistency in evaluation criteria and decision-making processes across different candidates and hiring processes, promoting fairness and transparency.
4. Continuous improvement: With regular updates and feedback mechanisms, the system can continuously improve its performance and adapt to evolving recruitment trends and organizational needs.

SYSTEM ANALYSIS

Software Requirements:

One of the most difficult tasks is that, the selection of the software. Once system

Requirement is known i.e., determining whether a particular software package fits the requirements.

Operating System: Windows Family.

Version: Python 3.9

Programming Language: Python

Development IDE: PyCharm community

Hardware Requirements:

The selection of hardware is very important in the existence and proper working of any software. In the selection of hardware, the size and the capacity requirements are also important

Processor : intel(R) core(tm) i5-8350ucpu@1,70 GHz 1.690 Speed : 1.90GHz(min)

RAM : 4GB&above

Hard Disk : 64GB&above

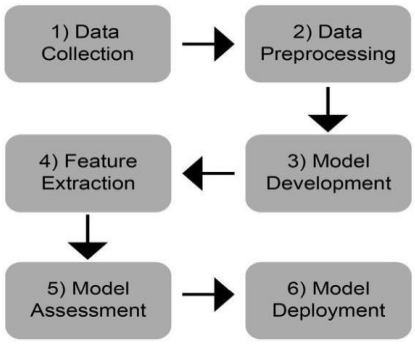


Fig: Project Life Cycle

Data Collection: In this stage, CVs or resumes are collected from individuals. These documents may be sourced from job applicants, online databases, or other sources.

Preprocessing: The collected CVs undergo preprocessing to clean and prepare the text data for

analysis. This may involve tasks such as removing irrelevant information, standardizing formatting, and tokenization.

Feature Extraction: Features are extracted from the preprocessed text data to represent various aspects of the individual's qualifications, experiences, skills, and personality traits. This could involve techniques such as bag-of- words representation, word embeddings, or other NLP methods.

Labeling: In supervised learning approaches, labeled data is required for training the prediction model. Personality traits may be labeled based on self-reported assessments or external evaluations.

Model Training: Machine learning models, such as regression or classification algorithms, are trained using the labeled data and extracted features. These models learn to map the input features to the corresponding personality traits.

Validation and Evaluation: The trained model is evaluated using validation techniques such as cross-validation to assess its performance and generalization ability. Evaluation metrics may include accuracy, precision, recall, or F1 score, depending on the specific goals of the analysis.

Model Assessment: Model assessment, in the context of machine learning, refers to the process of evaluating the performance and effectiveness of a trained model on unseen data.

SYSTEM DESIGN:

This system can be used in many business parts/areas that may require expert candidates. This system will reduce the workload of the (workers in general/hiring, training, and firing department). Based on the test, we can know the qualities and personality of a candidate, and through CV analysis, we can know the skills and qualifications of a person . using these two important factors, we can make the hiring process easy, fast and also help in hiring the right candidate with fair decision and select the appropriate candidate for a particular job profile .Personality development encourages people to interact with others.

Using Natural Language Processing (NLP) can be defined as a process that enables a machine to become more like a human, because of this deeply cutting the distance between machines and humans. This system will focus not only on qualification and inexperience but also focuses on other important aspects, which are needed/demanded for a particular job position.

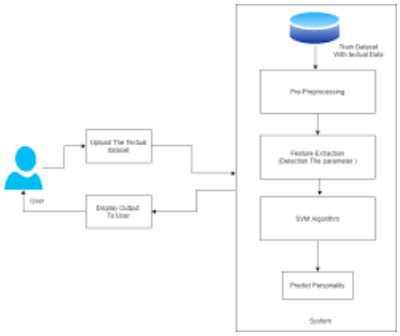


Fig: System Design

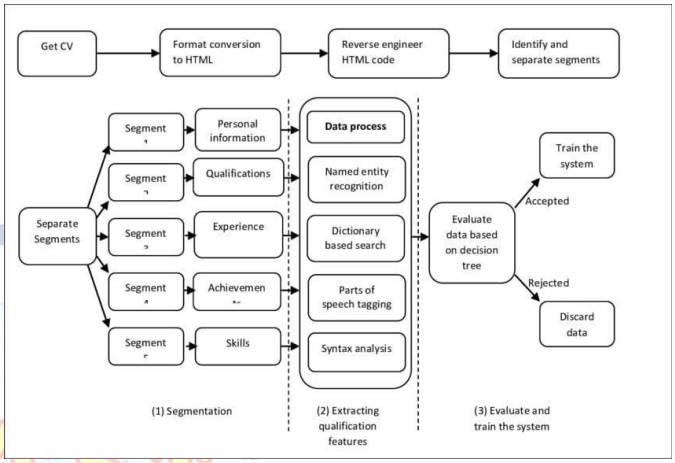


Fig: Block Diagram

The working of the system is first data was divided into different segments. Each segment contain personal information, Qualification, Achievements, Experience, Skills. After these are analyse with trained data and predict the result.

Curriculum Vitae (CV)

A curriculum vitae or "CV" may be a new and unfamiliar term for you. A CV is a structured outline of your education, publications, projects, awards, and employment history. It can vary in length from one to several pages, depending upon the variety and number of your experiences. A resume, in contrast, is normally a brief, one-page overview of your job experiences. A curriculum vitae is used primarily when applying for academic, educational, scientific, or research positions. It is also applicable when applying for fellowships or grants. (Smith J, 2006).

As with a resume, you may need different versions of a CV for different types of positions. Based on your education and experience, you will need to include sections that are most relevant to your career goal. We suggest you ask a graduate advisor or other faculty member to review your vitae for specific content and format, as they are experts in their field. In addition to

the basics of your name, contact information, education, and experience, a CV may include: i. Research Experience
Teaching Experience
Related Leadership Experience
Internship or Rotation Experience
Presentations & Publications
Awards, Grants, and Fellowships
Professional Affiliations
Licensure ix. Skills (lab techniques and equipment, computer programs, languages, etc.)

Natural Language Processing (NLP)

Natural language processing (NLP) is the intersection of computer science, linguistics, and machine learning. The field focuses on communication between computers and humans in natural language and NLP is all about making computers understand and generate human language. Applications of NLP techniques include voice assistants like Amazon's Alexa and Apple's Siri, but also things like machine translation and text-filtering (Niklas and Mathew, 2022). Natural language processing studies interactions between humans and computers to find ways for computers to process written and spoken words similar to how humans do. The field blends computer science, linguistics, and machine learning (Niklas et al., 2022).

Why Natural Processing Language is Difficult

Human language is special for several reasons. It is specifically constructed to convey the speaker/writer's meaning. It is a complex system, although little children can learn it quickly (Niklas et al., 2022). Another remarkable thing about human language is that it is all about symbols. According to Chris Manning, a machine learning professor at Stanford, it is a discrete, symbolic, categorical signaling system. This means we can convey the same meaning in different ways (i.e., speech, gesture, signs, etc.) The encoding by the human brain is a continuous pattern of activation by which the symbols are transmitted via continuous signals of sound and vision. (Niklas et al., 2022)

Understanding human language is considered a difficult task due to its complexity. For example, there are an infinite number of different ways to arrange words in a sentence. Also, words can have several meanings and contextual information is necessary to correctly interpret sentences. Every language is unique and ambiguous. Just look at the following newspaper headline "The Pope's baby steps on gays." This sentence has two very different interpretations, which is a pretty good example of the challenges in natural language processing. (Niklas et al., 2022)

Syntactic and Semantic Analysis:

The syntax is the grammatical structure of the text, whereas semantics is the meaning being conveyed. A syntactically correct sentence, however, is not always semantically correct. For example, "cows flow supremely" is grammatically valid (subject—verb — adverb) but it doesn't make any sense. (Niklas, 2022).

Syntactic Analysis: The syntactic analysis also referred to as syntax analysis or parsing is the process of analyzing natural language with the rules of formal grammar. Grammatical rules are applied to categories and groups of words, not individual words. The syntactic analysis assigns a semantic structure to text (Niklas et al., 2022).

Semantic Analysis: Semantic analysis is the process of understanding the meaning and interpretation of words, signs, and sentence structure. This lets computers partly understand natural language the way humans do. I say this partly because the semantic analysis is one of the toughest parts of natural language processing and it's not fully solved yet(Niklas et al., 2022)

Natural Language Processing Techniques for Understanding Text Parsing What is parsing? According to the dictionary, to parse is to "resolve a sentence into its parts and describe their syntactic roles." That nailed it, but it could be a little more comprehensive. Parsing refers to the formal analysis of a sentence by a computer into its constituents, which results in a parse tree showing their syntactic relation to one another in visual form, which can be used for further processing and understanding.

Stemming: Stemming is a technique that comes from morphology and information retrieval which is used in natural language processing for pre-processing and efficiency purposes. It's defined by the dictionary as to "originate in or be caused by."

Stemming is the process of reducing words to their word stem. A "stem" is part of a word that remains after the removal of all affixes. For example, the stem for the word "touched" is "touch." "Touch" is also the stem of "touching," and so on.

Text Segmentation: Text segmentation in natural language processing is the process of transforming text into meaningful units like words, sentences, different topics, the underlying intent, and more. Mostly, the text is segmented into its component words, which can be a

difficult task, depending on the language. This is again due to the complexity of human language. For example, it works relatively well in English to separate words by spaces, except for words like “icebox” that belong together but are separated by a space. The problem is that people sometimes also write it as “icebox”.

Named Entity Recognition: Named entity recognition (NER) concentrates on determining which items in a text (i.e., the “named entities”) can be located and classified into predefined categories. These categories can range from the names of persons, organizations, and locations to monetary values and percentages.

Relationship Extraction: Relationship extraction takes the named entities of NER and tries to identify the semantic relationships between them. This could mean, for example, finding out who is married to whom, that a person works for a specific company, and so on. This problem can also be transformed into a classification problem and a machine learning model can be trained for every relationship type.

Sentiment Analysis: Using sentiment analysis, we want to determine the attitude (i.e., the sentiment) of a speaker or writer concerning a document, interaction, or event. Therefore, it is a natural language processing problem where text needs to be understood in the underlying intent. The sentiment is mostly categorized into positive, negative, and neutral categories. Through the use of sentiment analysis, for example, we may want to predict a customer’s opinion and attitude about a product based on a review they wrote. Sentiment analysis is widely applied to reviews, surveys, documents, and much more.

Natural Language Toolkit

Natural Language Toolkit (NLTK) is a Python Package used to perform Natural Language Processing (NLP). It was created as a tool for implementing NLP with ease in python-based projects. The growth of unstructured data via social media, online reviews, and voice-based human computer interaction are some reasons why NLP has become a crucial part of modern technology. NLTK is a useful toolkit for many NLP applications such as morphological processing, syntax analysis, semantic analysis, pragmatic analysis, and automatic text summarization; NLTK is composed of sub-packages and modules. A typical processing pipeline in NLTK will call modules in sequence. Python data structures are passed from one module to another when using this library.

Big Five Personality Trait Model

In the latter half of 1950, the Big Five model was released. However, the current model was implemented in 1990. The prototype was given the moniker "The Big Five" by Lewis Goldberg, a research worker at the Oregon Research Institute. Currently, this prototype is thought to be accurate, and the accompanying personality gradation is routinely used by many businesses and in psychological research. The Big Five Personality Trait model, also known as the OCEAN model, is a widely used framework for assessing personality in psychology. It provides a summary of a person’s overall character. (Suyash, 2022) It contains the following:

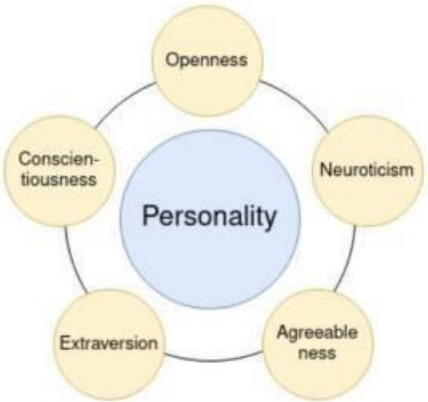
i.Openness: This trait encompasses characteristics such as insight, imagination, sensitivity, attentiveness, and curiosity. People who score high in openness are typically curious, creative, and open to new experiences.

ii.Conscientiousness: This trait relates to a person’s level of care, discipline, deliberation, and diligence. People who score high in conscientiousness are typically goal-oriented and have good self-control and organizational skills.

iii.Extroversion: This trait relates to a person’s level of emotional expression and assertiveness. Extroverted people are outgoing and comfortable interacting with others and tend to be enthusiastic and excitable.

iv.Agreeableness: This trait relates to a person’s level of generosity and cooperativeness. People who score high in agreeableness are typically kind, trusting, and considerate.

v.Neuroticism: This trait relates to a person’s emotional stability and tendency to experience negative emotions such as anxiety and depression. People who score high in neuroticism are more easily prone to mood swings and may be more sensitive to stress



RESULTS AND DISCUSSIONS:

This section discusses the detail of experimental materials and setting used in the research process such as coding environment, dataset, python modules, parameter settings, etc. Detail of the various python modules for reading, analyzing, and visualization of data as well as a step-by-step detail of the machine learning processes implementation and results are also discussed.

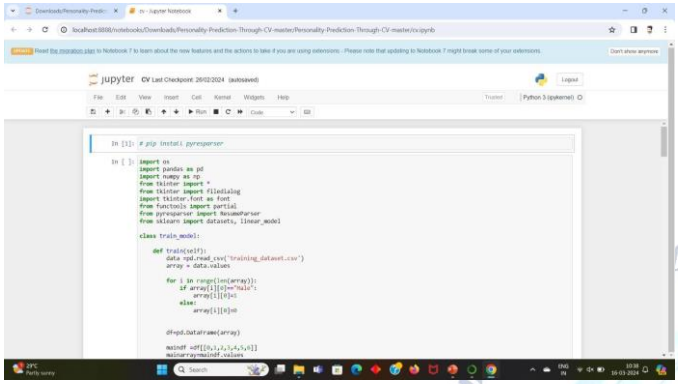


Fig: import libraries

This is show the which libraries are import in this project and which packages are used in this project.

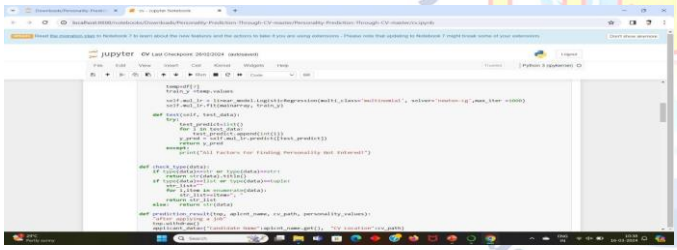


Fig: Test methods

This is showing the training and testing methods

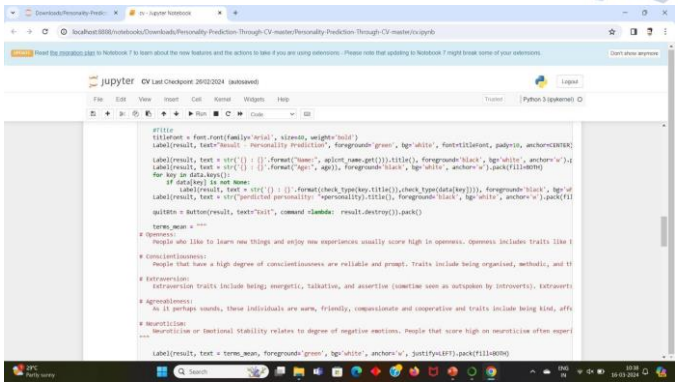


Fig: Personality Traits

This is showing the big five personality traits. These are used in AI technology for building a prediction system

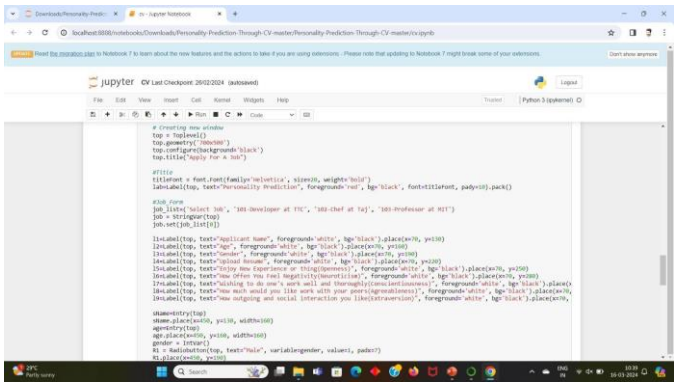


Fig: Title conformation

This is showing the title conformation code.

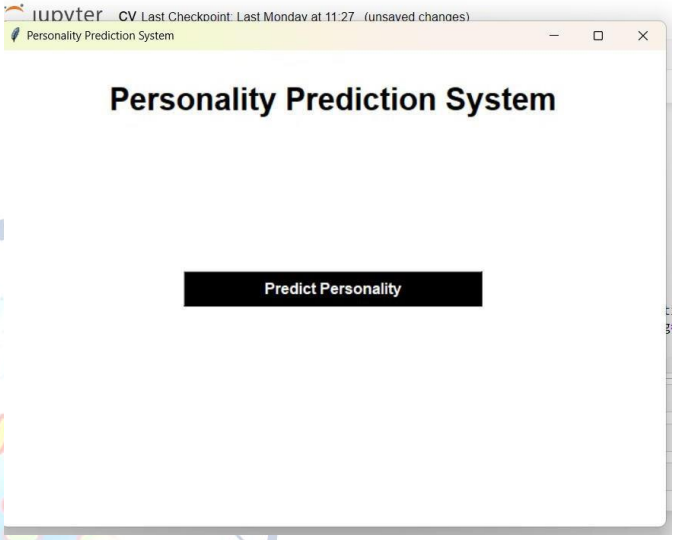


Fig: Output Web Page

First open the jupyter notebook. After open to implement the program by using python programming. We are using the libraries and datasets to develop the code. After develop to run the code by using run button. Whenever we run the code Fig: is displayed after click on the predict personality

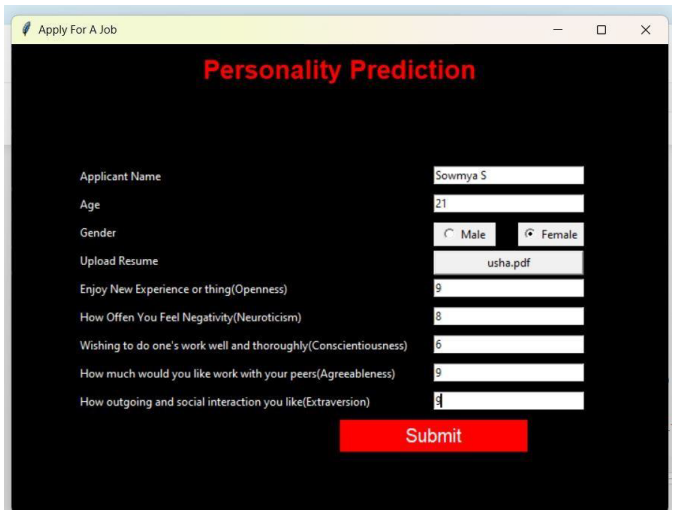


Fig: Result page

Fig: Test case 1

This is showing the result. Whenever we used to predict the person traits then the output will be coming like this. This output shows applicant details like name, age, resume stored path and traits.

Fig: Test case 2

This is showing the result. Whenever we used to predict the person traits then the output will be coming like this. This output shows applicant details like name, age, resume stored path and traits

Fig: Test case 3

This is showing the result. Whenever we used to predict the person traits then the output will be coming like this. This output shows applicant details like name, age, resume stored path and traits.

CONCLUSIONS

We have developed an organization-oriented recruitment system that aims to streamline and enhance the hiring process for Human Resource (HR) departments. The system is specifically designed to assist HR professionals in efficiently shortlisting the most suitable candidates for particular job profiles, thereby minimizing the time and effort required during the preliminary stages of recruitment. Recruitment is a critical function in every organization, yet it often becomes a time-consuming and labor-intensive process, especially when dealing with a high volume of applicants. Our system addresses this challenge by automating key aspects of candidate screening and evaluation. By leveraging structured data processing and intelligent filtering mechanisms, the system ensures that only the most relevant and qualified candidates are shortlisted for further consideration. This reduces the workload on HR departments and enables them to focus more on the final stages of candidate assessment and decision-making.

The system has been designed to be applicable across a wide range of business sectors. Any industry requiring skilled or specialized professionals can benefit from this recruitment framework. Its flexibility and adaptability make it a valuable tool for organizations of varying sizes and domains.

Features

Our recruitment system integrates a variety of features aimed at improving efficiency, accuracy, and user experience. Some of these features align with approaches highlighted in existing research studies, while others are unique innovations introduced in our implementation. Key features include:

Automated Candidate Shortlisting: The system screens applications based on predefined criteria such as skills, qualifications, and experience, thereby identifying suitable candidates more quickly.

User-Friendly Interface: The platform has been designed with ease of use in mind, ensuring smooth navigation for all stakeholders including applicants, HR administrators, and authorized job authorities.

Role-Based Access: Different levels of access are provided to users, administrators, and authentic job authorities to maintain data security and integrity.

Comprehensive Candidate Profiles: Applicants' details, CVs, and supporting documents are stored systematically, making them easily accessible for review and comparison.

Scalability Across Sectors: The framework can be deployed in multiple business environments, adapting to the requirements of different industries.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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