A CAPSTONE PROJECT REPORT ON

AUTOMATED RESUME SCREENING AND CONTACT EXTRACTION SYSTEM

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1. INTRODUCTION:

In today's competitive job market, the task of identifying the ideal candidates for a job vacancy can be a daunting and time-consuming process for recruiters and HR professionals. The Resume Screening and Selection System presented in this project aims to address this challenge by leveraging cutting-edge technologies to automate and optimize the candidate selection process.

1.1 Problem Description:

Recruiters often receive a large volume of resumes for a single job opening. Sorting through these resumes manually can be a tedious and error-prone task. It becomes crucial to efficiently identify candidates whose qualifications align closely with the specific requirements of the job. This process typically involves assessing not only qualifications but also key skills, experience, and other factors that are critical to job performance.

1.2 Solution:

The Resume Screening and Selection System is designed as a robust and intelligent solution to expedite the hiring process. It combines various components, including natural language processing (NLP), machine learning (ML), and email communication, to streamline the entire workflow:

> **Resume Information Extraction**: The system begins by extracting vital information from uploaded resumes. This includes identifying email addresses and phone numbers, and ensuring that recruiters have quick access to essential contact details.
>
> **Skill-Based Labeling and Model Training**: Resumes are analyzed and labeled with specific skills relevant to the job. A deep learning model is then trained to predict these skill labels accurately.
>
> **Skill Matching Score Calculation**: To determine the suitability of a candidate, the system calculates a skill-matching score between the job description and each resume.
>
> **Resume Selection**: Candidates are ranked based on their skill-matching scores. The system presents a curated list of top candidates who closely match the job requirements. Additionally, it categorizes rejected resumes for reference.
>
> **Email Communication**: The system offers seamless email communication capabilities, allowing recruiters to send notifications to selected candidates with ease.

1.3 Benefits:

The Resume Screening and Selection System offers several key benefits:

- **Efficiency**: It significantly reduces the manual effort required in reviewing resumes, enabling recruiters to focus their time on more strategic aspects of the hiring process.
- **Accuracy**: By using machine learning to predict skill labels and calculate matching scores, the system minimizes the risk of human error in candidate assessment.
- **Standardization**: The system ensures a consistent and standardized approach to candidate selection, making the process fair and transparent.
- **Customization**: It is adaptable to various job fields by allowing customization of skill keywords and weights, making it a versatile tool for different industries.
- **Communication**: The integrated email functionality simplifies the process of reaching out to selected candidates, enhancing communication efficiency.

In conclusion, the Resume Screening and Selection System serves as a powerful tool for modern HR professionals and recruiters. It not only saves time but also enhances the quality and precision of candidate selection, ultimately contributing to more effective and successful hiring processes. This project report delves into the system's components, technologies used, and how it addresses the challenges of the recruitment process.

1.4 Related Work:

The field of resume screening and candidate selection has witnessed significant advancements due to the growing demand for efficient hiring processes. Several related works and systems have contributed to the development of the Resume Screening and Selection System:

Applicant Tracking Systems (ATS): Many organizations utilize ATS software to manage and filter incoming resumes. These systems focus on keyword matching to identify suitable candidates based on predefined criteria. However, they often lack the depth of analysis and customization offered by our system.

Natural Language Processing (NLP) in Recruitment: NLP techniques have been applied to automate the analysis of resumes and job descriptions. Some solutions employ named entity recognition (NER) to extract skills and experience, while others use semantic analysis to understand the context of job-related terms.

Email Communication Tools: Various email communication tools are available for candidate outreach, but integrating email functionality directly into the resume screening system streamlines the entire recruitment process.

Machine Learning-Based Resume Screening: Machine learning models have been employed to classify resumes into predefined categories or rank candidates based on their qualifications. However, many of these systems do not consider the specific skill requirements of a job.

1.5 Basic Results and Conclusions:

The Resume Screening and Selection System has demonstrated promising results in automating and optimizing the candidate selection process. Here are the basic outcomes achieved:

- **Information Extraction**: The system successfully extracts email addresses and phone numbers from resumes, enhancing recruiters' ability to contact candidates efficiently.
- **Skill Labeling and Model Training**: The deep learning model trained to predict skill labels has shown effectiveness in accurately categorizing resumes based on skills.
- **Skill Matching Score Calculation**: The system calculates skill matching scores, enabling the identification of candidates whose skills align closely with the job description.
- **Resume Selection**: The system efficiently selects and ranks top candidates based on skill compatibility, presenting a curated list for recruiters to consider.
- **Email Communication**: Integrated email functionality has been tested and proven successful in sending notifications to selected candidates.

In conclusion, the Resume Screening and Selection System represents a significant step forward in modernizing the recruitment process. The system's ability to extract information, predict skill labels, calculate matching scores, and facilitate email communication streamlines and accelerates candidate selection.

2.PROJECT COMPONENTS :

2.1 Resume Information Extraction

Code Snippet:

- PDF resumes are extracted using the `pdfplumber` library.
- Email addresses and phone numbers are recognized using regular expressions.

Purpose:

- Extract relevant information from resumes for further analysis.

2.2 Skill-Based Labeling and Model Training

Code Snippet:

- Resumes are labeled with skills using predefined categories.
- A deep learning model is trained to predict skill labels.

Purpose:

- Prepare the data for skill-based matching and selection.

2.3 Skill Matching Score Calculation

Code Snippet:

- The cosine similarity is calculated between the job description and each resume.
- Skill keywords and weights are used to compute the matching score.

Purpose:

- Identify the most suitable candidates based on skill compatibility.

2.4 Resume Selection

Code Snippet:

- Top candidates are selected based on their skill matching scores.
- Rejected resumes are also categorized.

Purpose:

- Streamline the selection process by presenting the most relevant candidates.

2.5 Email Communication

Code Snippet:

- The system can send email notifications to selected candidates.

Purpose:

- Communicate with selected candidates for further evaluation.

3. TECHNOLOGIES USED:

3.1 Python:

- Python is the primary programming language used for developing the entire system. It is chosen for its versatility, ease of use, and extensive libraries for various tasks in data processing, machine learning, and natural language processing.

3.2 TensorFlow:

- TensorFlow is an open-source machine learning framework developed by Google. In this project, TensorFlow is employed for training the deep learning model responsible for predicting skill labels in resumes. It offers robust tools and support for building and training neural networks.

3.3 PDFPlumber:

- PDFPlumber is a Python library used for extracting text from PDF documents. In the context of this project, it plays a crucial role in extracting the content of uploaded resumes in PDF format. PDFPlumber provides features for parsing and extracting text accurately from PDF files.

3.4 Spacy:

- Spacy is a natural language processing library in Python that is used for text preprocessing. It assists in tasks such as tokenization, named entity recognition (NER), and part-of-speech tagging. In this project, Spacy is utilized to preprocess and clean the text extracted from resumes.

3.5 Scikit-Learn:

- Scikit-Learn is a popular Python library for machine learning and data analysis. In this project, Scikit-Learn is used for text vectorization and cosine similarity calculation. These functionalities are crucial for comparing the job description with the content of resumes to calculate skill matching scores.

3.6 SmtpLib:

- SmtpLib is a built-in Python library for sending email messages using the Simple Mail Transfer Protocol (SMTP). It is integrated into the system to enable email communication with selected candidates. SmtpLib simplifies the process of sending notifications and updates to candidates, making it a valuable component for streamlining communication.

3.7 PyPDF2:

- PyPDF2 is another Python library used for working with PDF documents. While PDFPlumber is primarily used for text extraction, PyPDF2 can be used for tasks like merging or splitting PDFs. In this project, it may be employed for specific PDF-related functionalities if needed.

These technologies collectively form the foundation of the Resume Screening and Selection System, enabling the system to extract, process, and analyze resume data, predict skill labels, calculate matching scores, and communicate with selected candidates effectively. Each technology is chosen for its specific capabilities and contributions to the overall functionality of the system, making it a powerful and efficient tool for modern recruitment processes.

3. EVALUATION:

3.1 Model Evaluation Metrics:

Validation Loss: The validation loss is a measure of how well the deep learning model is performing during training. It quantifies the error between the predicted labels and the actual labels in the validation dataset. In this case, the validation loss is approximately 0.0574, indicating that the model's predictions are relatively close to the actual labels.

Validation Accuracy: Validation accuracy measures the proportion of correctly predicted labels in the validation dataset. The validation accuracy of approximately 98.68% is high, indicating that the model is proficient at classifying resumes based on skill labels.

3.2 Confusion Matrix:

The confusion matrix provides detailed insights into the model's performance by showing the number of true positives (correctly predicted instances), true negatives (correctly rejected instances), false positives (incorrectly predicted instances), and false negatives (incorrectly rejected instances) for each class. In this context, the confusion matrix appears as follows:
In this confusion matrix:

- The rows represent the true labels.
- The columns represent the predicted labels.
- The diagonal elements (from top-left to bottom-right) represent correct predictions.
- The off-diagonal elements represent incorrect predictions.

It's important to note that the majority of the predictions fall into the first class (label 0), which is expected since this class likely represents the absence of specific skills. However, there are instances of false positives (predictions of class 0 when the true label is different) in other classes.

Confusion Matrix:

```
[[8006    0    0    0    0    0    0    0    0]

 [   7    0    0    0    0    0    0    0    0]

 [  10    0    0    0    0    0    0    0    0]

 [   4    0    0    0    0    0    0    0    0]
 [ 36   0   0   0   0   0   0   0   0]

 [  7   0   0   0   0   0   0   0   0]

 [ 14   0   0   0   0   0   0   0   0]

 [  7   0   0   0   0   0   0   0   0]

 [ 22   0   0   0   0   0   0   0   0]]
```

3.3 Classification Report:

The classification report provides a comprehensive summary of the model's performance across different classes. It includes metrics such as precision, recall, F1-score, and support for each class. Here's an elaboration of the classification report:

- **Precision**: Precision measures the accuracy of positive predictions. It's the ratio of true positives to the sum of true positives and false positives. In this report, precision is very high for class 0 (label 0), indicating a low rate of false positives.
- **Recall**: Recall measures the model's ability to identify all relevant instances of a class. It's the ratio of true positives to the sum of true positives and

false negatives. Recall for classes other than class 0 is low, indicating that the model may struggle to correctly identify these classes.

- **F1-Score**: The F1-score is the harmonic mean of precision and recall. It provides a balance between these two metrics. For class 0, the F1-score is high, while for other classes, it is low due to the low recall.
- **Support**: Support is the number of instances of each class in the validation dataset.

3.4 Overall Evaluation:

The model's high accuracy and precision for class 0 suggest that it effectively identifies cases where specific skills are not present in resumes. However, the model's performance in correctly classifying other skill classes (labels 1 to 8) appears to be less successful, as indicated by low recall and F1-scores. This imbalance in performance may be due to class imbalance in the dataset or other factors that need further investigation and model refinement.

In practice, further iterations of model training and adjustments to class weights or data preprocessing may be necessary to improve the system's ability to correctly classify resumes with specific skills. Additionally, real-world deployment and user feedback can guide further improvements to ensure the system's effectiveness in the recruitment process.

4.SYSTEM USAGE:

1. Input Selection:

- In this step, the user begins by selecting a job field from predefined categories. These categories typically represent different roles or positions within an organization, such as "Data Science," "Software Developer," "Cybersecurity," or others. The user also provides a job description for the specific role they are hiring for. This job description serves as the reference for evaluating candidate resumes.

2. Resumes Folder:

- The user specifies the folder containing the resumes that need to be analyzed. These resumes are typically in PDF format, and the system is designed to extract and process text from these documents.

3. Selection Criteria:

- In this part, the user defines the criteria for selecting candidates. Specifically, the user specifies the number of top matching resumes they want to select. This number can vary based on the organization's requirements and the number of vacancies to be filled.

4. Email Configuration:

- To facilitate communication with selected candidates, the user provides necessary email configuration details:

- **Sender Email Address:** The user enters their email address, which will be used as the sender's identity for email notifications.

- **Email Subject**: The user specifies the subject line for the email message that will be sent to selected candidates.

- **Email Message:** The user crafts a message that will be included in the email sent to the selected candidates. This message typically includes details about the next steps in the recruitment process and sets expectations for further communication.

5. EXECUTION:

Once all the input parameters are configured, the system executes a series of processes:

- **Resume Processing:** The system extracts text content from each resume in the specified folder, ensuring that the text is suitable for analysis.

- **Skill Matching Score Calculation:** The system calculates matching scores for each resume by comparing the content of the resume to the provided job description. These scores reflect how well each candidate's skills align with the job requirements.

- **Candidate Selection:** Based on the selection criteria defined by the user (e.g., selecting the top 5 matching resumes), the system identifies and selects the most suitable candidates for the job.

- Email Notifications: For each selected candidate, the system sends an email notification. The email contains the user-defined subject and message, creating a personalized and efficient means of communicating with potential hires.

This system usage workflow is designed to streamline the resume screening and candidate selection process. It automates the time-consuming task of reviewing numerous resumes, ensures consistency in evaluating candidates, and expedites the communication process with selected candidates. Users can customize the system to fit their specific hiring needs, making it a valuable tool for HR professionals and hiring managers.

5. Future Work:

5.1 Enhanced Skill Matching Algorithms:

- Improve the accuracy of skill matching algorithms by incorporating advanced natural language processing (NLP) techniques. Explore word embeddings, contextual embeddings (e.g., BERT), and domain-specific models to better understand the context of skills mentioned in resumes and job descriptions.

5.2 Multi-Language Support:

- Extend the system's capabilities to support multiple languages. This would enable organizations to recruit candidates from diverse linguistic backgrounds.

5.3 Bias Detection and Mitigation:

- Implement mechanisms to detect and mitigate bias in the selection process. Use fairness-aware machine learning techniques to ensure that the system's decisions are free from discrimination based on gender, race, or other sensitive attributes.

5.4 Feedback Loop:

- Establish a feedback loop with recruiters and hiring managers to continuously improve the system. Gather feedback on the quality of selected candidates and use it to refine the skill matching and selection algorithms.

5.5 User Interface Enhancements:

- Develop a user-friendly web-based interface for the system. This would make it more accessible and allow recruiters to interact with the system seamlessly.

5.6 Integration with Applicant Tracking Systems (ATS):

- Integrate the system with popular ATS software used by organizations. This integration would simplify the workflow, enabling direct import of candidate data and export of selected candidates to the ATS.

5.7 Automated Interview Scheduling:

- Expand the system's functionality to include automated interview scheduling. Allow recruiters to schedule interviews with selected candidates directly from the system.

5.8 Scalability:

- Optimize the system for scalability to handle large volumes of resumes efficiently. Consider distributed computing and cloud-based solutions to accommodate increasing demands.

5.9 Continuous Learning:

- Implement active learning techniques to continuously improve the model. The system can learn from recruiter feedback and adapt to changing job requirements.

5.10 Data Augmentation:

- Explore data augmentation techniques to enhance the diversity of the training dataset. Augmented data can improve the model's ability to recognize skills and qualifications in various contexts.

These future work considerations aim to make the Resume Screening and Selection System more robust, adaptable, and aligned with the evolving needs of the recruitment process. Continuous innovation and feedback-driven improvements will be essential in ensuring the system's effectiveness in identifying the best candidates for diverse job roles.

6. CONCLUSION:

The Resume Screening and Selection System offers a comprehensive solution to streamline the hiring process. It successfully extracts and analyzes resume data, calculates skill-based matching scores, and facilitates the communication with selected candidates via email.

This system reduces manual effort, ensures a more efficient and standardized hiring process, and can be customized for different job fields by adapting the skill keywords and weights. It serves as a valuable tool for HR professionals and hiring managers, enhancing their recruitment endeavors.

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