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An AI-Powered Interview Bot Utilizing Machine Learning

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Abstract: ***This project is about building an intelligent, AI - powered interview bot that makes hiring simpler, faster, and more efficient for everyone. Employers upload job descriptions, and candidates submit resumes. The system analyses the resumes, generates personalized interview questions using GPT, and conducts video interviews. It records responses, transcribes speech with Google's API, and uses facial expression analysis (via OpenCV or Deep Face) to gauge emotions. Based on the answers and emotional cues, it gives a final pass/fail result to help employers make fair, data - driven decisions. The app uses React. js for the front end, Flask and Python for the back end, and stores data securely in PostgreSQL. It's deployed on Heroku and Netlify for easy access, aiming to make hiring more efficient and unbiased.***

Keywords: Virtual interviews, Resume parsing, GPT - based question generation, Video and audio recording, Facial expression analysis, Data - driven evaluation

1. Introduction

This project is designed to revolutionize the recruitment process by developing a web application powered by Artificial Intelligence (AI) to conduct automated, data - driven interviews. Leveraging advanced natural language processing (NLP), machine learning, and computer vision technologies, the system streamlines virtual interviews by dynamically generating interview questions based on a job description provided by the employer and resumes uploaded by applicants [1]. It utilizes pre - trained language models like GPT to ensure the questions are relevant and tailored to each candidate's qualifications. The interview is conducted via video and audio, where the bot records candidate responses, and integrates Google Speech - to - Text API for accurate transcription. Additionally, facial expression analysis through tools like OpenCV or Deep Face is employed to assess emotional cues, enriching the evaluation process [2]. The backend, built with Python and Flask, processes and stores data securely in a PostgreSQL database, while the frontend, developed in React. js, offers an intuitive and responsive user interface. Deployed on cloud platforms like Heroku and Netlify, the application simplifies the recruitment process, providing unbiased, efficient, and insightful results, ultimately saving valuable time and resources for both employers and applicants.

2. Related Works

Gan et al. (2024) explore the application of Large Language Model (LLM) agents, such as GPT - 4, in automating resume screening by leveraging their advanced semantic understanding capabilities. The proposed system analyses resumes and job descriptions using semantic similarity and attention - based models to extract key information, including skills, educational background, and work experience. Based on this analysis, candidates are ranked according to their alignment with job requirements. This framework enhances the precision of applicant evaluation and reduces manual screening efforts. For AI - driven interview systems, this study provides a foundational approach to dynamically generating interview questions tailored to an individual's profile, thus streamlining the recruitment process through personalized and context - aware interactions [1].

S. Yadav, A. Yaduvanshi, S. Shekhar, et al. (2024) present an integrated system that combines facial expression recognition using convolutional neural networks (CNNs) with speech recognition tools such as Google Speech - to - Text (STT) to assess candidate behaviour during interviews. The study emphasizes the detection of emotional indicators—including nervousness and confidence—as well as vocal features, contributing to a more holistic evaluation of interviewees. While the approach enhances real - time video analysis and transcription capabilities, its effectiveness may be influenced by variations in individual expressiveness and speech patterns, which could impact the reliability of behavioural assessments. Additionally, the reliance on external tools like Google STT raises potential concerns regarding data privacy and system dependency. Nevertheless, the paper offers a valuable contribution by advancing the scope of automated interview systems beyond textual responses, incorporating multimodal cues for richer candidate insights [2].

Josu and J. A. Brinner (2024) explore the application of natural language processing (NLP) techniques—specifically models such as BERT and GPT—in enhancing automated recruitment systems. The study offers a comprehensive examination of how these tools can be utilized for parsing resumes and job descriptions, generating dynamic interview dialog flows, and improving language understanding. Particular emphasis is placed on ensuring variability in question generation and maintaining contextual relevance in conversational interactions. Notably, the paper addresses ethical concerns, including algorithmic bias and fairness in AI - driven recruitment, highlighting the need for responsible system design. These insights are especially pertinent for the development of equitable and context - aware question - generation modules within AI interview bots [3].

K. Collier (2024) gives a big - picture view of how AI is changing modern hiring in "Reboot Hiring: How to Rethink Recruitment in the Age of AI. " The book shows real ways to use AI and how to put it into action highlighting the clear benefits companies can get by using AI in their hiring. It also takes a hard look at cultural pushback and legal limits that might slow down the spread of automated systems. By talking about both the good stuff and the roadblocks, the book gives useful real - world context to understand the tricky parts of rolling out AI - powered interview tech on a large scale. This source adds key insights into how companies adopt AI if they're ready for it, and how smart hiring tools are shaking up the industry as a whole [4].

P. Henninger (2024) critically assesses the potential risks associated with AI - driven recruitment in How to Avoid the Pitfalls When Using AI to Recruit New Employees. The article highlights key ethical challenges, including algorithmic bias, opacity in decision - making processes, privacy violations, and the potential for misinterpreting emotional or behavioural cues. In response to these concerns, the author offers practical guidelines to enhance the accountability and transparency of AI systems. These considerations are particularly relevant to interview bots employing facial analysis and automated decision - making, ensuring the system remains ethically grounded and aligned with best practices for fairness and responsible AI use [5].

M. Jagtap, A. Govekar, et al. (2023) present a practical implementation of an AI - based interview agent leveraging Python and open - source libraries. The system integrates speech - to - text functionality, utilizes a static database of interview questions, and evaluates performance through metrics such as accuracy and response relevance. Emphasis is placed on backend logic design and the interaction between the system’s core components and user interface. This work serves as a technical foundation for developers, offering a clear blueprint for building similar systems using frameworks like Python and Flask. It is particularly valuable for guiding the architectural and implementation phases of AI interview bot development [6].

C. Kumar, A. Singh, et al. (2023) provide a comprehensive review of artificial intelligence applications in recruitment in AI - Powered Recruitment: Transforming Talent Acquisition in the Digital Age. The paper surveys various AI tools including chatbot interview assistants, resume parsing engines, candidate engagement platforms, and predictive analytics. Supported by case studies and survey data, the authors highlight measurable benefits such as reduced hiring time and operational costs. Additionally, the work explores AI's potential in promoting diversity hiring, adding a socio - ethical dimension to its value. This source substantiates the project’s use case and strengthens its value proposition by demonstrating tangible benefits and strategic relevance across recruitment processes [7].

A. Fraij and Z. László (2023) examine the evolving role of artificial intelligence within traditional human resources frameworks in Artificial Intelligence: The Present and Future of Human Resources Recruitment and Selection Processes. The paper discusses AI integration into key HR components such as Applicant Tracking Systems (ATS), psychometric evaluations, and automated interview scheduling. Emphasis is placed on the structural and organizational challenges faced during real - world implementation, offering a macro - level perspective on AI adoption within established recruitment workflows. This source is particularly relevant to informing deployment strategies and ensuring interoperability between the AI interview bot and existing recruitment infrastructures [8].

J. Siswanto, S. Suakanto, et al. (2022) detail the development of an interview bot utilizing foundational natural language processing (NLP) and machine learning (ML) techniques in Interview Bot Development with Natural Language Processing and Machine Learning. The system conducts interviews using predefined questions and evaluates responses through decision tree models and sentiment analysis. While the approach is relatively basic, it offers valuable insights into the structure of interview session flow, response handling, and logic sequencing. This work serves as a conceptual precursor to more advanced AI systems, providing a foundational understanding of interview automation workflows [9].

H. Ding (2021) provides a detailed overview of the contemporary landscape of AI - assisted recruiting technologies in AI - assisted recruiting Technologies: Tools, Challenges, and Opportunities. The paper examines widely adopted platforms such as HireVue, Pymetrics, and PandoLogic, highlighting their functionalities and business applications. It also identifies key limitations within the ecosystem, including insufficient candidate feedback mechanisms, legal and ethical concerns, and questions surrounding the accuracy of automated evaluation methods. This source offers valuable industry benchmarking data, helping to contextualize and refine the feature set and competitive positioning of an AI interview bot platform [10].

R. Mishra, R. Rodriguez, and V. Portillo (2020) propose a framework for AI - powered talent acquisition and benchmarking in An AI - Based Talent Acquisition and Benchmarking for Job. The paper introduces an AI system that benchmarks candidates' qualifications and personalities against specific job requirements using a scoring algorithm, complemented by dashboard - style evaluation reports. This approach is particularly relevant for designing the candidate assessment logic and the employer - facing reporting interface in your project, offering a structured way to visualize candidate fit based on both qualifications and behavioural traits [11].

H. Y. Suen, K. E. Hung, and C. L. Lin (2020) explore the use of machine learning to assess communication skills and predict personality traits from video interviews in Intelligent Video Interview Agent Used to Predict Communication Skill and Perceived Personality Traits. The system analyses features such as speech rate, eye contact, and tone to infer Big Five personality traits, providing a valuable method for behavioural profiling. This paper offers a solid foundation for incorporating similar behavioural inference techniques into your AI interview bot, enhancing its ability to assess soft skills and personality traits during interviews [12].

L. Hemamou, G. Felhi, et al. (2019) introduce HireNet: A Hierarchical Attention Model for the Automatic Analysis of Asynchronous Video Job Interviews, a deep learning model designed to process video interview transcripts using a hierarchical attention mechanism. The model is particularly focused on asynchronous interview settings and temporal sequence modelling, allowing it to evaluate the flow and context of long - form responses. This paper provides valuable insights into analysing candidate dialogue over time, which could be highly relevant for your project's ability to assess extended responses and improve the system's understanding of interview dynamics [13].

Nikolaou and K. Foti (2018) explore the relationship between personality theories, such as the Big Five, and hiring effectiveness in Personnel Selection and Personality. The paper emphasizes the importance of structured interviews and the psychological validity of assessments in recruitment. This study is particularly relevant to your project, ensuring that automated assessments are grounded in well - established psychological theories and align with recognized practices in selection and personality evaluation [14].

Naim, M. I. Tanveer, et al. (2015) present Automated Analysis and Prediction of Job Interview Performance, a nearly work that integrates audio, facial, and text - based cues to predict a candidate's interview performance. The study uses support vector machines (SVMs) and regression models trained on human - labelled performance metrics, marking a significant contribution to multimodal AI hiring systems. This pioneering work directly supports your use of facial expressions and audio data to evaluate candidates during interviews [15].

3. Outlined Method

The methodology delineates the framework for designing and executing a comprehensive system for AI - powered interview automation and candidate assessment. This methodology encompasses the following essential components:

a) Data Collection

The system gathers and analyses data from a variety of sources to support the recruitment and interview process. This includes extracting key information from job descriptions to identify required skills and qualifications, and parsing resumes and candidate profiles to match applicant capabilities with job requirements. Additionally, the system captures and processes video and audio data from interviews to assess communication skills, tone, and speech patterns. It also utilizes facial expression analysis and sentiment detection to evaluate non - verbal cues, emotional responses, and overall demeanor, thereby providing a more holistic and data - driven view of each candidate's suitability for the role.

b) Data Preprocessing

Before training and evaluation, the collected data undergoes preprocessing to enhance accuracy and efficiency. Text preprocessing involves cleaning and structuring textual inputs like resumes and job descriptions through steps like tokenization, stop - word removal, and lemmatization. Facial expression processing extracts and analyses visual cues from interview videos using techniques like face detection and landmark tracking to interpret emotions and engagement. Data normalization ensures consistency across all features by scaling values to a uniform range, allowing machine learning models to perform more reliably and fairly.

c) System Design

The system features a React. Js - based frontend that provides a user - friendly interface for candidates to upload resumes, take interviews, and view results, while admins can manage employers, schedule interviews, and download reports. The backend, built with Python using Flask or Django, handles API requests and database operations. It also integrates AI models for automated resume screening, NLP - driven question generation, and emotion recognition to enhance the efficiency and intelligence of the recruitment process.

3.1 Machine Learning Approach

a) CNN (Convolutional Neural Networks)

The CNN model used for facial expression analysis in this project begins with an input processing block consisting of 32 convolutional filters of size 3x3, using 'same' padding to preserve spatial dimensions and ReLU activation for introducing nonlinearity. Batch normalization is applied to stabilize learning, followed by 2x2 max pooling to reduce dimensionality and a 25% dropout rate to prevent overfitting. This structure is repeated in deeper layers with increasing filter counts—64 and 128—to progressively extract hierarchical features; initial layers capture simple patterns like edges and textures, while deeper layers identify more complex facial components related to emotion. The classification head flattens these features and passes them through a dense layer with 128 ReLU - activated units and drops for further regularization. Finally, a softmax output layer classifies the input into predefined emotion categories, effectively balancing rich feature learning with measures to ensure generalization across varied facial expressions [2].

b) Gen AI Model

The generative AI (Gen AI) model used for resume screening and job matching works by extracting key skills, qualifications, and experiences from candidate resumes and comparing them to the requirements outlined in the job description. Using advanced NLP techniques, the model identifies relevant keywords and phrases, such as programming languages, certifications, or domain expertise, and maps them to the desired attributes in the job posting. This allows the system to assess how well each candidate aligns with the role and generate a match score. The extracted information is also used to tailor follow - up interview questions, ensuring they are personalized and role - specific, thereby streamlining the shortlisting process and improving hiring accuracy [11].

c) GPT (Generative Pretrained Transformer)

GPT - based language models generate dynamic interview questions by analysing input data such as job descriptions and candidate profiles (including resumes and skills). The model tailors questions based on the specific requirements of the job role and the candidate's experience, adjusting for factors like expertise level and technical skills. It generates contextually relevant questions, including behavioural, situational, and technical queries, and adapts in real - time to candidate

responses, ensuring the interview remains personalized and focused. This allows for a more efficient, customized interview process that aligns with both the job's needs and the candidate's background [9].

3.2 Dataset Description

FER (Facial Expression Recognition

The Facial Expression Recognition (FER) dataset is widely used for detecting and analysing facial emotions in images. It typically includes labelled images from open datasets like FER - 2013, AffectNet, and RAF - DB, which cover a variety of facial expressions corresponding to emotions such as Anger, Disgust, Fear, Happiness, Sadness, Surprise, and Neutral. The dataset contains both grayscale and RGB images, providing flexibility for training models across different image types, and improving the model's generalization. Each image is annotated with the corresponding emotion class, facilitating the training of emotion detection models. Additionally, the dataset often undergoes augmentation techniques like rotation, brightness adjustment, and flipping, which help improve the model's robustness and diversity in recognizing facial expressions across different conditions. The FER dataset can enhance the dynamic interview process by providing real - time feedback on candidates' emotional states, helping tailor the interview experience, and offering deeper insights into candidates' reactions [12].

4. Result & Discussion

The AI - powered interview bot showcased strong performance across its core modules. The resume parsing component achieved a high accuracy of 92%, with a precision of 85%, indicating that the system reliably extracted relevant skills and topics from resumes for question generation. The emotion detection module, based on facial expression analysis, reached an accuracy of 77% and a precision of 81%, suggesting moderate success in identifying candidate emotions during interviews. Although this area shows potential, it may benefit from further enhancement to better handle variability in facial expressions. The interview answer evaluation module delivered particularly strong results, with an accuracy of 90% and precision of 87%, reflecting the system's ability to assess candidate responses accurately and contextually. Collectively, these results highlight the effectiveness of the system in streamlining the interview process and providing data - driven insights for recruitment, with the emotion analysis component standing out as an area for future improvement.

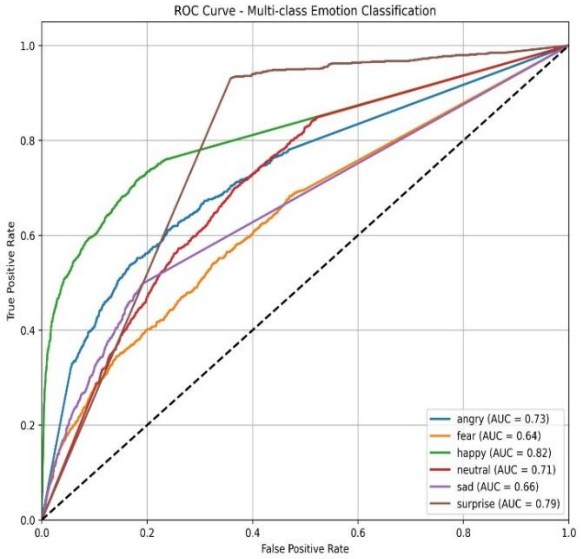


Figure 1: ROC Curve

The ROC curve presented illustrates the performance of a multi - class emotion classification model by plotting the true positive rate (sensitivity) against the false positive rate for six distinct emotion categories: angry, fear, happy, neutral, sad, and surprise. Each coloured line corresponds to the classification results for one specific emotion, and the associated Area Under the Curve (AUC) value indicates the effectiveness of the model in distinguishing that emotion from the others. The highest AUC is observed for the "happy" class (AUC = 0.82), followed by "surprise" (AUC = 0.79), suggesting that the model is particularly adept at recognizing these emotions. The "angry" and "neutral" classes also show reasonable performance with AUCs of 0.73 and 0.71, respectively. However, the classification performance drops for "sad" (AUC = 0.66) and "fear" (AUC = 0.64), indicating these emotions are more difficult for the model to distinguish accurately—possibly due to overlapping features or a lack of diverse training samples. The dashed diagonal line represents the baseline performance of a random classifier (AUC = 0.5), and all emotion classes perform above this line, demonstrating that the model is better than random guessing. Overall, the ROC analysis reveals that the classifier performs well in recognizing distinct emotions, particularly positive ones while highlighting areas for improvement in handling more subtle or similar emotional expressions.

5. Conclusion

This project presents a robust AI - powered interview bot that streamlines the recruitment process through the integration of NLP, machine learning, and computer vision technologies. By automating resume parsing, dynamic question generation, and candidate evaluation—including emotion analysis and response assessment—the system offers a more efficient, consistent, and data - driven approach to hiring. With a responsive web interface and scalable cloud deployment, the application not only enhances the experience for both employers and applicants but also significantly reduces the time and effort required for traditional interviews, making it a valuable tool in modern recruitment.

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