

Institution Details



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| **Province** | Sindh | **City** | Karachi |
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Project Details



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| --- | --- | --- | --- | --- | --- | --- |
| **Project Title** | **AI – Powered Candidate Assessment System** | | |  | |  |
| **Group Details** | **Member 1 Name:** Ashesh Kumar    **Member 1 Roll#:** 21k-3451 | | **Member 2 Name:** Abdul Wasay    **Member 2 Roll#:** 21k-4589 | | **Member 3 Name:** Fahad Ahmed  **Member 3 Roll#:** 21k-4926 |  |
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| **Project Area of** | Web Development, Artificial Intelligence | | | | |  |
| **Specialization** |  |  | |  | |  |
|  |  |  | |  | |  |
| **Project Start** | (As per FYP Calendar) | **Project End Date** | | (As per FYP Calendar) | |  |
| **Date** |  |  | |  | |  |

## Project Summary:

In today’s fast-paced and competitive job market, companies face significant challenges in efficiently filtering and assessing candidates for technical roles. Recruitment for such positions often requires reviewing numerous CVs and conducting detailed technical interviews, both of which are time-consuming and resource intensive. This project aims to address these challenges by leveraging artificial intelligence (AI) to automate two critical stages of the recruitment process: CV analysis and technical interview conduction.

The AI-powered system will begin by analyzing candidates’ CVs to evaluate their alignment with the job’s specific skill requirements. Utilizing BERT (Bidirectional Encoder Representations from Transformers), the AI will assess each candidate’s qualifications, experience, and skills against predefined job criteria, such as technical expertise, educational background, and relevant industry experience. This approach provides a nuanced understanding of the CV content, enabling more accurate candidate filtering.

Once a candidate passes the initial screening, the AI will progress to the interview stage, where it will generate a customized technical assessment. Leveraging the GPT (Generative Pre-trained Transformer) model, the system will create tailored questions based on the specific technical demands of the role. These questions may include coding challenges, multiple-choice questions (MCQs), or other relevant formats, depending on the position.

The final component of the project involves the automated evaluation of candidate responses. For coding submissions, an integrated compiler will assess the correctness and efficiency of the code. Responses to MCQs and theoretical questions will be evaluated for accuracy and relevance using AI-based scoring methods. The system will then generate a comprehensive report, providing HR teams with actionable insights to make informed decisions with minimal manual effort.

Ultimately, this project seeks to streamline the recruitment process by automating the filtering and assessment of candidates, thereby reducing the workload on HR teams and making technical hiring more efficient, accurate, and scalable.

## Project Objectives:

1. To **develop an AI-based system** that automates the screening of candidate CVs to match job-specific technical and educational criteria.
2. To **implement an AI-driven interview system** that generates tailored technical questions, covering formats such as coding challenges, multiple-choice questions (MCQs), and theoretical assessments.
3. To **automate the evaluation of technical assessments**.
4. To **provide HR teams with reports** summarizing candidate performance in CV screening and technical assessments, reducing the need for manual review and decision-making.
5. To **enhance the efficiency** of the recruitment process by enabling the system to handle large volumes of applicants, reducing time and cost in hiring technical talent.
6. To **ensure compatibility with various CV formats** by building a flexible CV parser that can handle diverse document types (e.g., PDF, Word, plain text), ensuring comprehensive analysis across all candidates.
7. To **develop an intuitive user interface** for HR teams, allowing them to easily manage, review, and interact with candidate reports and technical assessments generated by the system.

## Literature Review:

The integration of Artificial Intelligence (AI) into recruitment processes has become a pivotal area of research, particularly as organizations seek to enhance efficiency and reduce biases in hiring. This literature review synthesizes key findings from recent studies that explore the applications of AI in recruitment, focusing on CV analysis, candidate screening, and interview processes. The review highlights both the benefits and challenges associated with AI adoption in hiring practices.

**AI Techniques in Recruitment:**

A comprehensive review by Albaroudi et al. (2024) discusses various AI techniques aimed at addressing algorithmic bias in job hiring. The authors emphasize that while AI can streamline candidate selection, it also raises concerns about fairness and transparency. Their study advocates for a collaborative approach between humans and AI tools to mitigate biases and enhance workforce diversity [1].

Furthermore, Chen et al. (2022) investigates the collaboration between recruiters and AI systems. Their findings indicate that AI can significantly improve the efficiency of resume screening by analyzing large datasets and identifying patterns that human recruiters might overlook. However, the study also notes a reluctance among HR professionals to fully embrace AI during interviews due to concerns about the technology's limitations in assessing soft skills and cultural fit [5].

**Challenges and Limitations:**

Despite the advantages of AI in recruitment, several challenges persist. Lundvall (2022) identifies key barriers to AI adoption in hiring processes, including technological knowledge gaps among HR professionals and their apprehension regarding AI's potential to replace human judgment. The study suggests that organizations need to foster a culture of learning about AI to leverage its full potential effectively [6].

Moreover, Upadhyay and Khandelwal (2023) highlight that while AI tools can enhance candidate sourcing and screening, there is significant resistance to their application during the interview phase. Many HR professionals’ express concerns about maintaining a personal touch in candidate interactions, which they believe is crucial for building rapport and assessing candidates holistically [4].

**Future Directions:**

The literature indicates a growing recognition of AI's transformative potential in recruitment. As organizations increasingly adopt AI technologies like BERT for CV analysis and GPT for generating interview questions, it becomes essential to balance automation with human oversight. Future research should focus on developing frameworks that integrate AI tools while ensuring ethical considerations are addressed, particularly concerning bias mitigation and candidate experience.

In conclusion AI presents opportunities for optimizing recruitment processes such as reducing time spent on CV screening and enhancing candidate engagement.

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## Project Implementation Method:

The project implementation method will involve the following steps:

1. **Research and planning**: Conduct a thorough analysis of the current recruitment landscape, identify pain points, and define the project's scope and objectives.
2. **System architecture design**: Develop a comprehensive system architecture that integrates the key components of the platform, including CV parsing, job matching, test generation, and automated evaluation.
3. **AI model integration**: Integrate AI models into the platform for natural language processing tasks, such as CV parsing and test generation.
4. **User interface design and development**: Design and develop a user-friendly web interface that provides a seamless experience for both candidates and recruiters.
5. **Testing and optimization**: Conduct thorough testing of the platform's functionality, performance, and user experience, and make necessary optimizations to ensure a high-quality product.
6. **Documentation and deployment**: Document the project's methodology, implementation details, and results, and deploy the platform for use by companies in the recruitment industry.

A diagram of a software development process

Description automatically generated

## Benefits of the Project:

This project introduces a range of benefits that will revolutionize traditional recruitment processes:

1. **Efficiency and Timesaving**:

By automating the CV screening and interview/test generation, the time spent on manually reviewing resumes and conducting interviews is significantly reduced. This allows recruiters to focus their efforts on final interviews and decision-making, improving overall productivity.

1. **Consistency and Objectivity**:

The system ensures that all candidates are evaluated using the same criteria, removing potential biases introduced by human reviewers. This leads to more consistent hiring decisions based purely on skills and qualifications, promoting fairness in the recruitment process.

1. **Increasing Candidate Quality:**

The use of tailored assessments ensures that candidates are evaluated based on relevant skills and knowledge, improving the overall quality of hires.

1. **Customization**:

The system is highly adaptable to various job roles and industries. GPT can generate specialized questions based on different technical requirements, while BERT can be fine-tuned to prioritize specific qualifications in CVs depending on the role.

1. **Cost Reduction**:

The automation of recruitment tasks minimizes the need for additional human resources, leading to cost savings. Additionally, faster processing of candidates shortens the overall hiring cycle, which is financially beneficial for companies.

1. **Data-driven Insights**:

The system can provide detailed analytics on candidate performance, such as strengths and weaknesses in specific areas, enabling companies to make more informed decisions. This data can also be used for refining future recruitment strategies.

1. **Scalability**:

The AI-driven recruitment system can handle large volumes of applicants without the need for additional resources. Whether a company receives hundreds or thousands of applications, the system can process them efficiently, making it scalable for small startups and large enterprises alike.

## Technical Details of the Final Deliverable:

The final deliverable will consist of the following modules:

1. **CV Analysis Module (BERT-based):**  
   This module uses the BERT (Bidirectional Encoder Representations from Transformers) model to process and analyze candidate CVs. It performs keyword extraction, semantic understanding, and job-specific matching by comparing the candidate's qualifications, skills, and experiences with the predefined job criteria. The module supports multiple document formats (PDF, DOCX, TXT) and ensures accurate parsing and analysis across various CV layouts.
2. **Interview Question Generation Module**   
   Leveraging artificial intelligence, this module dynamically generates a set of technical interview questions tailored to the role’s requirements and the candidate's profile. The questions include a mix of coding challenges, multiple-choice questions (MCQs), and theoretical problems. The module adapts the difficulty of questions based on job requirements, ensuring that they are relevant to the technical level expected for the position.
3. **Coding Assessment and Compiler Module:**  
   This component integrates a backend compiler to evaluate coding challenges submitted by candidates. The compiler runs the candidate's code, assessing it for correctness, efficiency, and compliance with coding standards. It supports multiple programming languages (e.g., Python, Java, C++), ensuring versatility in testing candidates with different technical backgrounds.
4. **MCQ and Theoretical Question Evaluation Module:**  
   This module automates the evaluation of MCQs and theoretical answers using AI-based scoring methods. For MCQs, it automatically calculates the score based on correctness. For theoretical responses, it uses natural language processing (NLP) techniques to assess the relevance and quality of the answers, reducing manual effort by HR teams.
5. **Candidate Performance Reporting Module:**  
   After the candidate's responses have been processed, this module generates performance reports, summarizing results from the CV analysis, coding assessment, MCQ, and theoretical question evaluations. The reports are structured to provide HR teams with actionable insights for decision-making, including overall candidate ranking, specific strengths, and areas of concern.
6. **HR Interface and Dashboard:**  
   The system includes a user-friendly web interface for HR teams to manage the recruitment process. It allows for real-time tracking of candidates, viewing reports, and adjusting job-specific criteria. The dashboard is designed to support scalability, allowing HR teams to manage large volumes of candidates simultaneously.

## Core Industry:

Human Resources and Recruitment Technology

## Core Technology:

The core technology for this project revolves around the integration of **Artificial Intelligence (AI)** with the **MERN stack**, which consists of **MongoDB**, **Express.js**, **React.js**, and **Node.js**. This combination allows for the development of a robust, scalable, and efficient recruitment system capable of automating the CV analysis and technical interview processes.

1. **MERN Stack**:

The MERN stack provides a comprehensive framework for building the application:

* **MongoDB**: This NoSQL database will store candidate data, including CVs, assessment results, and user interactions. Its flexible document-based structure allows for efficient data retrieval and management.
* **Express.js**: As a web application framework for Node.js, Express.js will handle server-side logic, including API endpoints for interacting with the database and managing user requests throughout the recruitment process.
* **React.js**: This JavaScript library will be used to build a dynamic user interface that enhances user experience. It enables real-time updates and interactive elements, making it easier for HR teams to navigate through candidate evaluations and reports.
* **Node.js**: Serving as the server-side environment, Node.js allows for executing JavaScript code on the server. It provides a non-blocking I/O model that ensures high performance and scalability, essential for handling multiple recruitment processes concurrently.

1. **Artificial Intelligence (AI):**

AI plays a pivotal role in enhancing the recruitment process through two primary models:

* **BERT (Bidirectional Encoder Representations from Transformers)**: This model will be utilized for analyzing candidates' CVs. BERT's advanced natural language processing capabilities enable it to understand and evaluate the context and nuances of the text within CVs. By assessing qualifications, experience, and skills against predefined job criteria, BERT facilitates precise candidate filtering, ensuring that only those who meet the specific requirements progress to the next stage of recruitment.
* **GPT (Generative Pre-trained Transformer)**: This model will be employed to generate customized technical assessments during the interview process. GPT's ability to create context-aware questions tailored to the specific demands of various technical roles allows for a more relevant and effective evaluation of candidates' skills. The generated assessments may include coding challenges, multiple-choice questions (MCQs), or other formats suited to the position.

## Project Key Milestones:

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| **Elapsed time in since start of the project** | **Milestone** | **Deliverable** |
| Month 1 | Research and Planning | Finalized project plan.  Selection of AI models (BERT, GPT).  Initial system architecture draft. |
| Month 2 | System Design and Data Preparation | Detailed system architecture.  Dataset collection (CVs, job descriptions).  Finalized database schema.  Preprocessing pipeline for CVs and job descriptions. |
| Month 3 | CV Parsing Module Development | Initial BERT-based CV parsing module.  Integration of job description matching.  Parsed dataset for model training. |
| Month 4 | Fine-tuning AI Model | Fine-tuned BERT model for CV classification.  Initial tests on parsing and job matching. |
| Month 5 | GPT Model Integration for Question Generation | Fine-tuned GPT model for interview question generation.  Initial testing of question relevance. |
| Month 6 | Core System Integration and Testing | Full integration of CV parsing and question generation.  Unit and integration tests for data flow. |
| Month 7 | Automated Evaluation and Report Generation | Coding assessment and automated scoring system.  MCQ and theoretical answer evaluation.  Performance reports for HR teams. |
| Month 8 | Final Testing, Optimization, and Deployment | Complete UI for HR teams.  Final testing and debugging.  System deployment.  Documentation of the system. |

## References:

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4. Upadhyay, A., & Khandelwal, T., “Exploring the Applicability of Artificial Intelligence in Recruitment”, *SCIRP*, 2023.
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