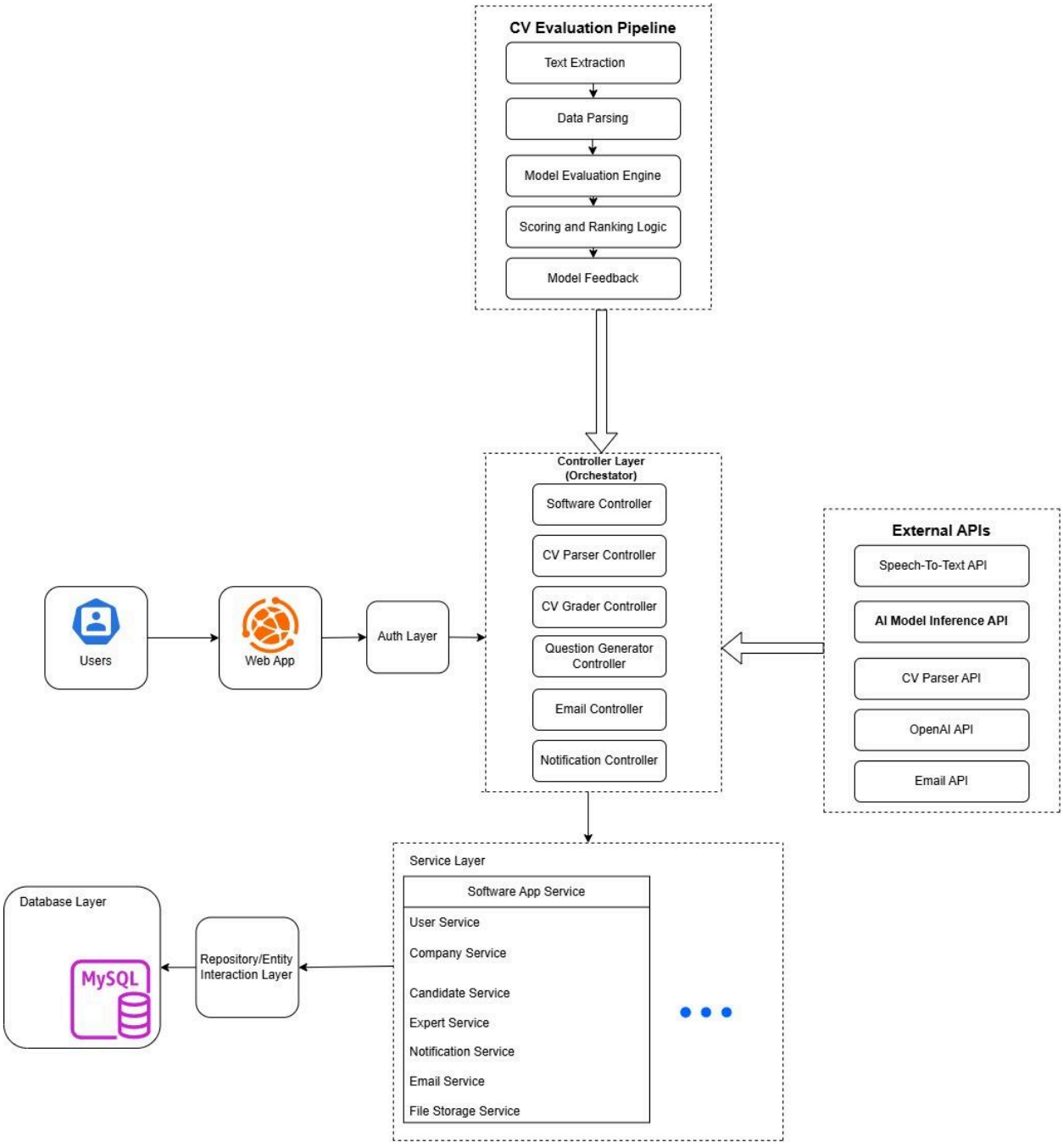
1. Introduction

1.1. Description

Recruit4Me aims to provide a web based software platform for hiring IT & tech professionals while hosting numerous features enhanced by technologies including AI & ML. Project proposes high innovation through two main stages, automated candidate elimination and pay as you go interviewer expert hiring done by companies. This way companies with limited HR resources and large applicant pools will reduce costs by AI automation, followed by HR & technical expert hiring for conducting candidate elimination. Thus, with pay as you go hiring, further employment opportunities will be introduced for interviewer experts, who also may be employed in some full time job, proposing extra revenue. First stage of Recruit4Me will consist of automation tools, which companies can use, including CV parsing ML model labeling candidates' technical and soft skills, AI generated technical questions relevant to the job position, and speech to text models. This first phase will reduce HR labor cost by performing automated and accurate preliminary candidate elimination. Furthermore, companies will be able to customize these models with respect to their professional and ethical principles. Subsequently, the second phase, interview expert hiring, will involve companies employing HR and technical experts for managing their recruitment. Given permission, interview experts will also manage candidate pools and introduce new potential candidates. Recruit4Me will also include searching and filtering candidates' profiles by their skills, job listings by required expertise and skills, enabling further interaction.

1.2. High Level System Architecture & Components of Proposed Solution



(Figure 1 High Level System Architecture Diagram)

HLSA

Recruit4Me is decomposed into structured layers for enabling modularity throughout development and to support unit testing, and better debugging. This high level system architecture diagram demonstrates the main structure we expect to conform throughout development, however, is also subject to change.

Web App Layer

All frontend user interactions will take place in the web app layer. This layer provides a responsive and user-friendly interface for all types of actors, including candidates, HR personnel, and experts. The web app will be designed to satisfy a rich, yet, user-friendly experience. React Js will be used for this particular purpose which offers broad options and simplifies the process. App will be both mobile and desktop compatible, ensuring accessibility for all users.

Auth Layer

Protecting information security and encapsulation, the auth layer is important. It is required for dynamic token generation, user authentication and authorization. In addition, it will include features such as CAPTCHA to prevent brute-force attacks and a system to send emails through an SMTP server with use of an email API for account verification and notifications.

Controller Layer

The controller layer is the first backend layer that handles and responds to HTTP requests. It contains several controllers:

- Software Controller: Manages interactions with the backend's main application service.
- CV Parser Controller: Connects to external AI APIs for CV parsing functionality.
- CV Grader Controller: Interfaces with AI systems to assess and grade CVs.
- Question Generator Controller: Generates questions dynamically using AI-based APIs.
- Email Controller: Handles email operations, such as sending notifications or account-related communications.
- Notification Controller: Manages push notifications or in-app notifications for users.

The controller layer serves as an orchestrator, connecting external AI APIs and backend services.

External AI APIs Layer

This layer comprises third-party APIs and custom AI/ML models used to enhance system functionality. It includes:

- Speech-to-Text API: Converts audio responses into text for analysis during interviews.
- AI Model Inference API: Handles requests for inference from custom AI/ML models developed in-house.
- CV Parser API: Extracts structured data from candidate CVs.
- OpenAI API: Powers advanced AI-based features like text generation or analysis.

- Email API: Facilitates robust email communication with external systems.

Service Layer

The service layer contains the business logic of the system. It acts as a bridge between the controller layer and the repository/entity interaction layer. Key services include:

- User Service: Manages user-related operations like registration and authentication.
- Company Service: Handles company-specific data and operations.
- Candidate Service: Processes candidate-related data and interactions.
- Expert Service: Manages tasks and actions performed by domain experts.
- Notification Service: Handles notifications for various system events.
- Email Service: Manages email-related operations, including notifications and account recovery.
- File Storage Service: Facilitates uploading and retrieving files, such as CVs and supporting documents.

Repository/Entity Interaction Layer

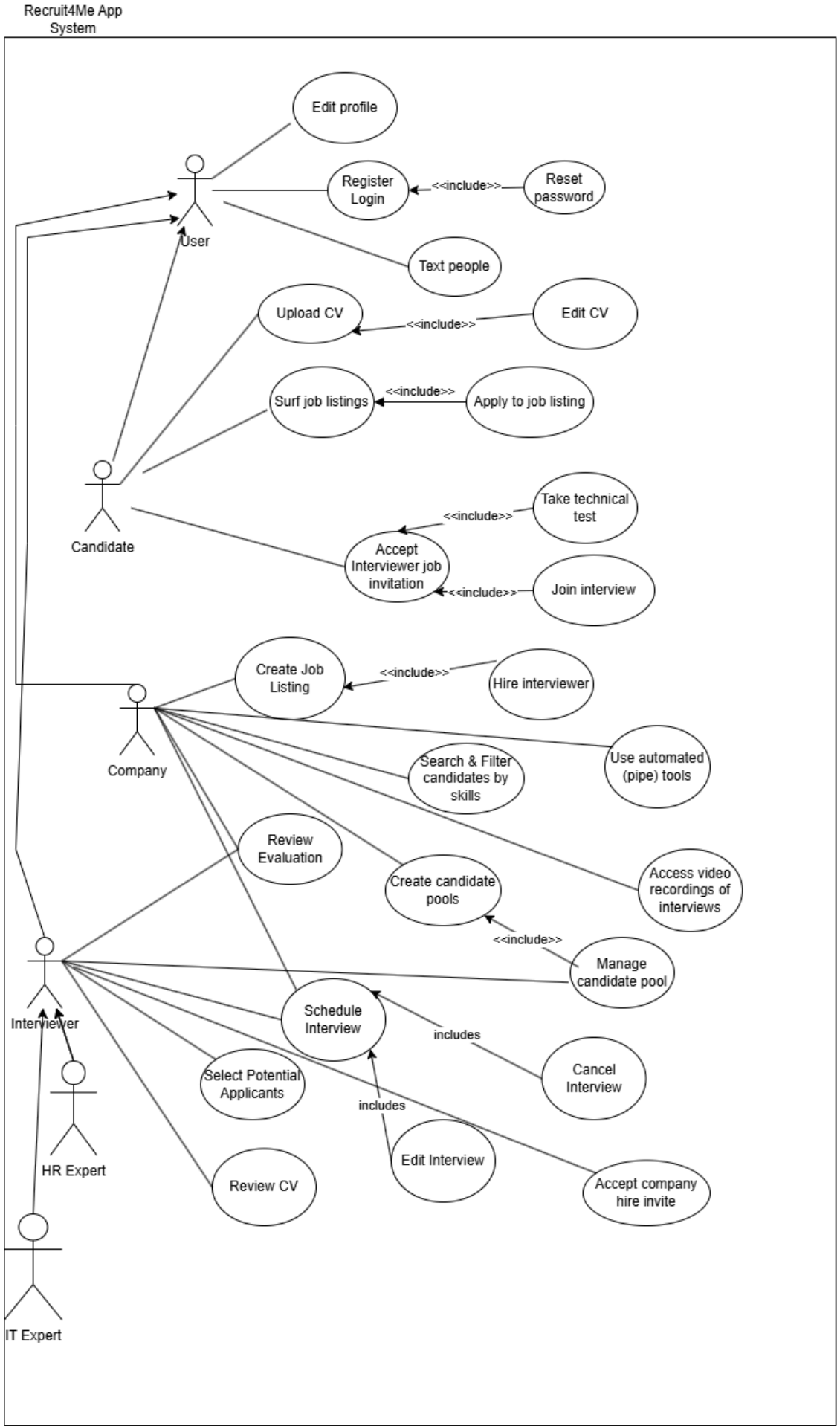
This layer will consist of files in which data flowing through service files will be read queries containing the data will be executed. Multiple repository files are expected to be used for different systems or actors.

Database Layer

Database layer will contain database instances and relevant tuples for maintaining information of Recruit4Me. While we mainly consider using MySQL especially for the software part, we may use other database instances from different technologies including PostgreSQL. In addition, we may use NoSQL libraries such as Redis too depending on our needs.

Initial Use Case Diagram

The following use case diagram depicts actors of Recruit4Me and their related use cases. While this diagram is subject to change, it demonstrates overall functionality of the system:


Recruit4Me App System
Edit profile
Register Login
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Reset password
User
Text people
Upload CV
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Edit CV
Surf job listings
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Apply to job listing
Candidate
Take technical test
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Accept Interviewer job invitation
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Create Job Listing
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Hire interviewer
Company
Use automated (pipe) tools
Search & Filter candidates by skills
Review Evaluation
Create candidate pools
Access video recordings of interviews
<<include>>
Manage candidate pool
Interviewer
Schedule Interview
includes
Cancel Interview
Select Potential Applicants
includes
Edit Interview
HR Expert
Review CV
Accept company hire invite
IT Expert

1.3. Constraints

1.3.1. Implementation Constraints

- System will be designed using React for front-end, Python or PHP for backend development.
- Predefined APIs are needed to utilize speech-to-text processes such as Google Speech-to-text or AWS Transcribe.
- Parsing resumes will require skill extraction thus integration of external tools (SpaCy, third-party APIs).
- A secure database is needed(PostgreSQL or MongoDB) to store candidate records and test results.
- Platform should be scalable to handle large data of candidates and companies.
- Protocols making the application secure will be used such as OAuth2 or SSO.
- System will be hosted by a cloud platform (AWS, Azure or GCP) to increase availability and reliability.
- In a certain(now undefined) period video data must be deleted from the database to ensure high availability in the backend.

1.3.2. Economic Constraints

- In resume parsing, with support of NLP and predefined models from the team, potential API costs will be minimized.
- Open-source solutions will be implemented first to see effectiveness before using large scale APIs like Google Speech-to-text or AWS Transcribe.
- Google cloud platform will be used in free trial initially, which utilizes Compute Engine instances and BigQuery for data analysis.
- Amazon Web Services(AWS) offers free EC2 instances, Lambda functions and RDS for a limited duration, which will be analyzed to ensure if it is proper for early-stage development.
- Google Speech-to-text requires approximately 50 TL per hour for real-time transcription. AWS Transcribe has a similar pricing, lower volumes can be managed however large scale candidate pools will require budget evaluation.
- Nvidia T4 GPUs on GCP cost approximately 30 TL per hour for on-demand usage. With sustained usage discounts, costs could drop to around 21000 TL for a single GPU instance.
- Amazon EC2 P4 instances with Nvidia A100 GPUs are more powerful but cost around 72000 TL, which is suitable for high-performance tasks but may be excessive for lighter AI workloads.
- Efforts should be made to optimize these resources by scheduling GPU usage only during model training or evaluation processes.
- A modestly scaled deployment (e.g., 2 vCPUs, 8GB RAM, and 50GB storage) on AWS or GCP costs around 650 to 2000 TL per month.

Adding auto-scaling capabilities for peak periods could slightly increase this price.

- Managed database services like AWS RDS or GCP Cloud SQL cost approximately 1000 to 3500 TL per month depending on storage and performance needs.
- Regular updates, monitoring, and bug fixes will require developer hours. Allocating team resources efficiently is crucial to avoid unnecessary expenditures.

1.3.3. Ethical Constraints

- System must ensure that all evaluations and eliminations are objective and free from bias based on factors such as gender, ethnicity, nationality or other non-technical factors. Which means that grading should be based on skill sets, experiences and test performances.
- Communication skills ratings must be standardized by using well-defined criteria, such as clarity, grammar, and coherence, or some factors explicitly indicated by the company to avoid subjective judgments and potential biases.
- AI model should be regularly checked for unintentional bias in the predefined algorithms and data handling to ensure fair treatment of all candidates.
- All candidate data, including resumes, test results, and recordings, must comply with GDPR or other relevant data protection regulations, depending on the region.
- Recordings should be stored for no longer than a certain period, as specified, and deleted securely afterward.
- Notifications sent to candidates about results, feedback, or interviews must respect their privacy preferences and include clear opt-out options for future communication.
- Encryption should be used to protect sensitive data during transmission and storage, ensuring the highest level of security.
- For a possible built-in messaging in application encryption should be made to protect privacy.
- For candidates eliminated by the system, the reasons must be explained in a transparent and professional manner, including data points such as skill gaps, test scores, or evaluation criteria.
- All third-party tools integrated into the system, such as resume parsers, speech-to-text APIs, or scheduling platforms, must comply with strict ethical standards and avoid misuse of candidate data.

1.4. Professional and Ethical Issues

Recruit4Me will be implemented based on professional and ethical standards to be reliable in terms of fairness, transparency and accountability. Robust data privacy measures will protect user information along with dynamic token generation, authentication and authorization of the accounts and comply with GDPR kind of regulations. It is crucial to avoid

biased decision-making in CV grading and candidate evaluation based on factors such as gender, ethnicity and race. AI datasets will utilize diverse datasets to resolve this issue. This application will ensure ethical use of external and third-party APIs and services which is a subject matter to be trustworthy and maintain integrity.

1.5. Standards

Recruit4Me will be implemented in compliance with global standards to ensure security and reliability. Data protection requires GDPR(General Data Protection Regulation) to be followed and safeguard user privacy, providing data consent, access and modification. WCAG(Web Content Accessibility Guidelines) will be prioritized so that keyboard navigation, high-contrast and similar supporting mechanisms will simplify the usability for individuals. For security the application will obey OWASP guidelines, which contribute to protection against common vulnerabilities such as SQL injection cross-site scripting (XSS). ISO/IEC 27001 for information security and ISO/IEC 29100 for privacy will be compiled. RESTful APIs will be utilized which adheres W3C web standards for cross-browser compatibility and third-party tools integration. Implementing these standards, Recruit4Me will become a secure, accessible and reliable platform for users.

2. Design Requirements

2.1. Functional Requirements

- Users should upload their resumes in either pdf or word (docx) format.
- The required skill sets should be extracted from the resumes
- Candidates should be filtered based on the companies' requirements
- Technical and non-technical questions should be generated based on company's need and required skill set
- Online tests should be created
- Candidates answers should be evaluated
- While answering the questions, candidates should be recorded and those records should stored at most 2 weeks
- Real time speech-to-text should be used
- Analyze the candidates answer's relevance and correctness
- Candidates should also be rated based on their communication skills
- The system should discard some of the candidates without human interaction. While eliminating some candidates, the system should consider resumes and candidates' test scores.
- The candidates who are successful in automated elimination should be called for an HR interview.
- Both candidates and HR specialists should be informed about the interview by notifications.
- Candidates should be informed about their performance and get feedback.
- System should be IT specific and evaluations are made on following specialities:

    - Data Scientist
    - Data Engineer
    - Machine Learning Engineer
    - Big Data Engineer
    - Software Engineer
    - Fullstack Engineer
    - DevOps Engineer
    - Embedded Systems Engineer
    - Cloud Engineer
    - Cybersecurity Engineer
- Based on candidates performance, reports should be generated
- Authentication should be used to distinguish the HRs, candidates, companies and tech specialists
- External tools also be used for retrieving more information about candidates
- Integration with third party scheduling programs should be implemented.

2.2. Non-Functional Requirements

2.2.1. Usability

Recruit4Me prioritizes a user-friendly and intuitive interface to ensure smooth navigation for all users, including candidates, HR personnel, and experts. The system will feature responsive design, accessible functionality compliant with WCAG standards, and real-time feedback through form validation and tooltips. Multi-language support and a built-in FAQ system are expected to enhance user experience and accessibility, making the platform approachable for a diverse audience.

2.2.2. Reliability

The application will be implemented to have a high reliability, which should be fault-tolerant. Robust error handling and proper data management using ACID-compliant databases will assist these to make an advancement for reliability. Load balancers, failover servers and automated backups with efficient fallback mechanisms are planned to be implemented to maintain an uninterrupted service experience for the users.

2.2.3. Performance

Performance optimization is a core part of Recruit4Me, with fast response times for key features like login, CV parsing and getting candidate results. Asynchronous operations and caching will reduce server load, while database optimization ensures efficiency even with large datasets. Stress testing guarantees the system can handle significant user traffic and heavy workloads without degrading performance.

2.2.4. Supportability

Recruit4Me is built with modularity and maintainability in mind, ensuring easy debugging, updates, and enhancements. Comprehensive logging, monitoring, and documentation support developers, while CI/CD pipelines and extensive test coverage enable safe and seamless deployment of updates without disrupting user operations.

2.2.5. Scalability

The application will be designed to handle increased workload during peak times and user-load through proper cloud integration(AWS, Google) and database optimization methods such as sharding and replication. It will support horizontal scaling and microservices, to ensure the system can manage growth of workload without affecting performance.

3. Feasibility Discussions

Tech Stack Considerations

The application is aimed to be built with robust and scalable technologies to provide optimal performance:

- Frontend: ReactJS for responsive, intuitive user interfaces across the web.
- Backend: Python or PHP to handle modularity and ease of integration with AI/ML models.
- AI/ML Models: OpenAI APIs, SpaCy, and in-house ML tools for CV parsing, question generation, and soft skills analysis.
- Databases: PostgreSQL or MySQL, with potential NoSQL solutions.

Budget Constraints

The project is designed to minimize both implementation and development costs.

- Initial Development: By prioritizing open-source tools and free-tier cloud services (e.g., AWS and GCP trials), Recruit4Me reduces upfront expenses.
- Long-Term Affordability: Pay-as-you-go pricing models and modular subscriptions ensure budget flexibility for companies of all sizes. So that it is feasible to use and adapt to a company.

Infrastructure

Cloud hosting through AWS ensures scalability, reliability, and high availability.

Integration Requirements

The application can be designed to enable connection with other related HR tools such as Slack and Microsoft Teams. Open API architecture enables easy connection with third-party tools, ensuring adaptability.

User Base

Recruit4Me is designed to serve a broad spectrum of users, from small teams of 5–10 HR personnel to larger enterprises managing thousands of candidates.

Ethical Concerns

Recruit4Me prioritizes ethical AI practices:

- Bias Mitigation: Models are audited regularly to ensure fairness in hiring, regardless of gender, ethnicity, or background.
- Data Privacy: Compliance with GDPR and similar regulations ensures candidate data is protected and transparent.
- Candidate Feedback: Providing detailed, actionable feedback enhances trust and supports ethical treatment of applicants.

3.1. Market & Competitive Analysis

Market Needs

- Affordability for Small Businesses: Platforms like HireVue and Codility may become inaccessible for small and mid-sized companies because of usage costs.
- Flexibility: Since pay-to-go method is not used and rigid subscriptions are existent in such apps, companies pay for tools they do not use.
- Comprehensive Evaluations: Most platforms focus on technical skills and coding ability but lack tools for soft skill and cultural fit analysis. Also in some apps if the company wants to be more specific about the coding ability needed, they need to write their own test code environment which can increase initial time to use the app.
- Narrow Candidate Pool: These apps only use the data of the candidates who apply for the job and do not mimic headhunters, narrow candidate pool can lead to insufficient applicants and wrong AI scoring.

Competitor Comparisons

- HireVue: Offers high technology interview assessment with also emphasis on soft skills but lacks technical interviewing and focus on niche technical requirements for a technical job. Also since AI is used thoroughly, costs are high.
- Codility: Excelling on coding challenges but fails to address soft skills assessments. Also initial configuration for coding challenges may be implemented manually and it increases initial time spent to use the app and is not user friendly.

- HackerRank: Overwhelms smaller teams with its cost and complexity. Also strong on coding but not very strong on soft skill assessment and uses a candidate pool only from the people who apply.

Recruit4Me's Unique Offerings

- Accessibility for All Business Sizes: Better than other options for small and mid sized enterprises in terms of cost and reduces unnecessary overhead for specific job descriptions. Also pay-as-you-go expert hiring that allows companies to hire HR professionals minimizes cost and improves flexibility.
- Customizable Candidate Evaluation: Companies can tailor assessments to specific job roles and cultural expectations, ensuring relevance and precision. Soft skills are also evaluated so more detailed evaluation is done. Coding environments and coding challenges can also be generated by AI without the overhead for users. Also platforms such as Google Warmup can be used to generate specific technical questions.
- Talent Pools: The application can be configured to select from local talent pools or global. Since it does CV parsing and can evaluate CV data for specific jobs, the application can provide better data and scoring among candidates.
- User-Friendly Environment: Users that use these applications state that they become more stressful when the coding challenges have a time limit and also when they are alone. This process can be gamified or can be arranged in a way that the applicant is more comfortable when answering the questions.

3.2. Academic Analysis

Ethical AI in Recruitment

Research highlights the risks of bias in AI-driven recruitment systems. Recruit4Me addresses these challenges by:

- Utilizing diverse datasets for model training.
- Regularly testing algorithms to ensure fairness and inclusivity.

NLP and AI for CV Parsing

Advanced NLP techniques (e.g., SpaCy, transformer models) are leveraged to extract not just skills but contextual information, identifying transferable skills often overlooked by traditional systems. This supports diversity and expands talent pools.

Collaborative Opportunities

Collaborating with universities and AI research centers can provide:

- Access to diverse datasets.
- Insights into reducing bias and improving recruitment fairness.
- Partnerships to publish findings that can be helpful for both applicants and can create a better appeal for the application.

Academic Analysis

Ethical AI in Recruitment

While the risks of biased AI-driven recruitment systems are underlined, Recruit4Me helps fix such challenges with the following:

- Utilizing diverse datasets for model training.
- Regular testing of the algorithms to make them fair and inclusive.

NLP and AI for Parsing of CV

It elicits such skills, along with other contextual information, using advanced NLP techniques such as SpaCy and transformer models. These models are able to pick up transferable skills that often get missed out by the older systems, hence promoting diversity and increasing talent pools.

Opportunities for Collaboration

Collaborating with other institutions and research can provide:

- Access to varied data sets and insights into reducing bias.
- Partnerships to publish findings that can be helpful for both applicants and can create a better appeal for the application.

4. Glossary

- **HR (Human Resources):** HR department in an organization is responsible for managing employee-related functionalities, such as recruitment, training, rating performance and workplace policies. In the Recruit4Me application, HR is a major part of the system, handling large volumes of candidate applications and assisting automation. This system facilitates CV parsing, rating candidates, test generation and execution, scheduling interviews which minimize manual interventions. HR can focus on efficiently hiring a candidate with assistance of this automation. AI and ML will further enhance HR operations by providing unbiased data and evaluation of applicants.

- **AI (Artificial Intelligence):** Artificial intelligence aids in developing the systems which are capable of doing tasks which mostly require human intelligence, such as decision-making, natural language processing(NLP), and recognition of patterns. In Recruit4Me, AI will be crucial in automatization of the candidate evaluation process. Speech-to-Text for online interview response evaluation, generating questions based on level and domain of the candidate with the assistance of multiple APIs such as OpenAI. These will ensure HR workflows stay consistent and unbiased.

- **ML (Machine Learning):** ML is an AI component which focuses on building algorithms, models to learn from data and make predictions beforehand without explicit programming. In Recruit4Me, ML will be utilized in the CV evaluation pipeline, where the Model Evaluation Engine is used. These compose of tasks such as analyzing candidate CVs for requested qualifications by the company, rating

candidates based on a predefined criteria, and give them ranks to develop assessment for further states of the laboring. ML algorithms provide feedback for improvement in addition, and continuously refine the evaluation methods as more data is gained, increasing accuracy and reliability of the system.

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