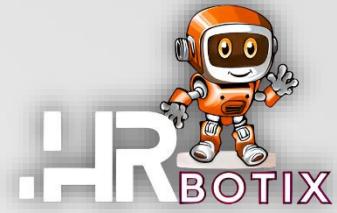




The Egyptian E-Learning University (EELU)

Faculty of Computer & Information  
Technology



# AI-Enhanced Human Resource Management System

"HRBotix System"

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## LIST OF ABBREVIATIONS

Abbreviation	Meaning
AI	<b>Artificial Intelligence</b>
HR	<b>Human Resources</b>
ML	<b>Machine Learning</b>
NLP	<b>Natural Language Processing</b>
CV	<b>Curriculum Vitae</b>
HRIS	<b>Human Resource Information Systems</b>
AI-EHRMS	<b>AI-Enhanced Human Resource Management System</b>
RF	<b>Random Forest Classifier</b>
SGD	<b>Stochastic Gradient Descent</b>
LINEAR SVM	<b>Linear Support Vector Machine</b>
TF	<b>TensorFlow</b>
DOC2VEC	<b>representing documents as a vector</b>

# Abstract

Our project targets challenges in AI-driven HR systems, enhancing model adaptability with a Universal CV Format Parser and advanced NLP and ML algorithms.

By collaborating with professional networks, fostering data enrichment, and implementing user-friendly interfaces, we address data scarcity and elevate job matching.

With dynamic model training, transfer learning, and document source compatibility, our AI-enhanced system transforms HR management, facilitating seamless candidate-job matching and empowering companies in performance analysis.



## 1.1 Background of the Study

### **Explanation of traditional HR management practices**

In the traditional paradigm of HR management, activities such as recruitment, training, payroll, and performance management were largely manual and paper-based. HR professionals were primarily administrative, handling routine tasks and paperwork. The emphasis was on compliance and personnel administration, with limited strategic involvement in organizational decision-making.

These traditional practices, while effective in their time, often proved time-consuming, resource-intensive, and prone to errors. As organizations evolved and the business landscape became more dynamic, there emerged a need for a more strategic and technology-driven approach to HR management.

### **Evolution of HRM with the advent of technology**

The advent of technology marked a significant turning point in HRM. The introduction of Human Resource Information Systems (HRIS) streamlined many administrative processes, automating tasks such as payroll processing, attendance tracking, and record-keeping. This shift allowed HR professionals to focus more on strategic aspects of human capital management.

Over time, the evolution continued with the integration of advanced technologies like cloud computing, data analytics, and mobile applications. These technological advancements not only enhanced the efficiency of HR processes but also paved the way for a more data-driven and employee-centric approach.

### **Current trends in AI and their impact on HRM**

In recent years, the emergence of Artificial Intelligence (AI) has brought about transformative changes in HRM. AI applications, such as machine learning algorithms, natural language processing, and predictive analytics, have enabled HR professionals to make more informed decisions. Recruitment processes have become more intelligent with AI-driven candidate matching and predictive analytics for identifying high-potential employees.

Additionally, AI has facilitated the development of chatbots and virtual assistants to enhance employee engagement and support. Automation of routine tasks has freed up HR professionals to focus on strategic initiatives, fostering a more proactive and agile HRM approach.

As we delve into the current trends in AI and their impact on HRM, it becomes imperative to explore the challenges and opportunities that arise. Understanding the implications of these advancements is essential for organizations aiming to leverage technology for optimizing their human capital management strategies.

By exploring the evolution from traditional HRM practices to the current trends in AI, this study aims to provide insights into the changing landscape of HRM and its implications for organizational success in the contemporary business environment.

## 1.2 Problem Statement

### **Identification of the challenges faced by HR departments**

The traditional job recruitment process is marred by geographical constraints, excessive paperwork, and high advertising costs in print media. Job seekers face challenges in accessing information about latest opportunities, hindering their chances of securing employment even when meeting eligibility criteria.

Even after technological development, there are still problems in modern systems for managing the recruitment process, so we conducted a study on 3 research papers.

In the realm of AI-EHRMS, a common challenge derived from 3 distinct research papers is the:

- limited adaptability and inclusivity of the machine learning models employed in resume recommendation,
- Job matching, and CV evaluation.

These models face constraints such as format restrictions, data scarcity, and potential bias, hindering their widespread applicability and effectiveness.

The limited adaptability and inclusivity of machine learning models can hinder HR departments' ability to efficiently handle the recruitment process. Issues like format restrictions may lead to difficulties in processing diverse resume formats, while data scarcity could limit the pool of information available for decision-making.

Additionally, potential bias in models poses a risk of unfair evaluations, impacting HR's goal of fair and unbiased candidate assessment. Overcoming these challenges is essential for HR departments to leverage technology effectively in managing recruitment processes. Old HR systems faced another challenge to rank candidates based on job requirements and past successful hires, overcoming it, will improve the quality of candidates that are moved forward in the hiring process.

### How AI can address specific HR inefficiencies

AI has the potential to profoundly transform HR processes, from recruitment and onboarding to performance management. By using AI-based tools and technologies, HR departments can automate mundane tasks like data entry and candidate screening, freeing up valuable time for more strategic decision-making. AI has the potential to revolutionize HR operations in a few ways.

Here are some examples:

- ◆ **Streamlining recruitment:** AI can help HR teams identify and screen potential candidates more efficiently by automating tasks such as resume screening and candidate communication. This can save time and resources while ensuring that HR teams can focus on the most qualified candidates.
- ◆ **Improving employee engagement:** AI-powered tools can help HR teams measure employee sentiment and engagement by analyzing data such as survey responses, performance metrics, and even social media activity. This can help HR teams identify areas of concern and take proactive steps to improve employee satisfaction.
- ◆ **Enhancing employee development:** AI can be used to personalize employee training and development programs by analyzing individual learning styles, preferences, and performance data. This can help HR teams create more effective training programs that are tailored to each employee's unique needs and strengths.
- ◆ **Automating administrative tasks:** HR departments often spend a significant amount of time on administrative tasks such as data entry, record-keeping, and benefits administration. AI-powered tools can automate many of these tasks, freeing up HR teams to focus on more strategic initiatives.

Overall, AI has the potential to transform HR by making processes more efficient, data-driven, and personalized, allowing HR teams to focus on strategic initiatives and ultimately improve the employee experience.

### The gap in current HR systems that AI could bridge.

The identified challenges in current HR systems create a significant gap that AI has the potential to bridge. The existing limitations include:

1. **Automated Resume Screening:** AI can streamline the initial stages of recruitment by automating resume screening processes. This ensures a quicker and more objective evaluation of candidates, saving HR professionals valuable time.
2. **Enhanced Candidate Matching:** AI algorithms can analyze job requirements and candidate profiles to provide more accurate and efficient matching. This improves the chances of finding the right candidates for specific roles, reducing the time and resources spent on recruitment.

**3. Personalized Employee Development:** AI-powered systems can assess individual employees' skills, performance, and learning preferences. This allows for personalized training and development plans, addressing specific needs and fostering continuous improvement.

**4. Chatbots for Employee Support:** AI-driven chatbots can provide instant support to employees by answering queries related to HR policies, benefits, and other routine matters. This ensures timely assistance and frees up HR professionals for more complex tasks.

**5. Data-Driven Decision Making:** AI enables HR departments to analyze vast amounts of data to derive insights into workforce trends, employee engagement, and performance metrics. This data-driven approach facilitates more informed decision-making.

**6. Predictive Analytics for Retention:** AI algorithms can predict potential employee turnover by analyzing various factors. HR can proactively implement retention strategies to address issues before they escalate.

Implementing AI in HR systems requires careful consideration of ethical concerns, transparency, and ensuring that these technologies align with organizational values. Additionally, providing proper training for HR professionals to effectively use and interpret AI-driven insights is crucial for successful integration.

### 1.3 Objectives of the Study

**General Objective:** To explore the potential of AI in enhancing HRM practices.

AI has the potential to transform every aspect of HRM, from recruitment and talent acquisition to employee engagement and retention, and even performance management and evaluation.

By leveraging AI-powered tools and technologies, HR departments can streamline processes, reduce manual errors, and make data-driven decisions.

#### Specific Objectives:

**To determine the benefits of integrating AI into HR systems.**

**AI-powered Recruitment and Talent Acquisition**

Recruitment and talent acquisition are critical functions for any organization. AI has brought significant advancements in this area by automating and optimizing the hiring process. AI-powered tools can sift through resumes, analyze candidate profiles, and identify the best matches for specific roles. This not only saves time but also ensures a more objective and unbiased selection process.

Furthermore, AI can also assist in talent sourcing by scanning various online platforms and social media channels to identify potential candidates who may not have actively applied for a job. This widens the talent pool.

## AI-enabled Performance Management and Evaluation

Traditional performance management systems often suffer from biases and subjectivity.

AI can address these challenges by providing a more objective and data-driven approach to performance management and evaluation. Through continuous monitoring and analysis of employee performance data, AI can identify areas for improvement, provide personalized feedback, and even predict future performance.

AI-powered performance management systems can also facilitate real-time feedback and recognition, fostering a culture of continuous improvement and growth within the organization.

## The Evolution of HRM: From Traditional to Cutting-Edge

Traditionally, HRM focused on tasks such as recruitment, training, and payroll management. However, with the advancements in technology and the increasing complexity of the workforce, HRM has undergone a paradigm shift. It has become a strategic function that aligns with the overall goals and objectives of the organization.

One of the key factors that has contributed to the changing landscape of HRM is the emergence of Artificial Intelligence (AI). AI has revolutionized the way HRM functions are carried out, enabling organizations to enhance efficiency and accuracy in their HR practices.

## AI-driven Employee Engagement and Retention Strategies

AI-powered chatbots and virtual assistants can also enhance employee experience by providing instant support and guidance on HR-related queries. This not only improves efficiency but also ensures that employees feel valued and supported.

**To identify the key functions AI can serve in AI-EHRMS.**

### 1. Resume Parsing and Candidate Screening:

- Function:* Natural Language Processing (NLP) to interpret and extract relevant information from resumes.
- Benefit:* Saves time by quickly identifying the most qualified candidates from large applicant pools.

### 2. Applicant Tracking and Ranking:

- Function:* Machine Learning algorithms to rank candidates based on job requirements and past successful hires.
- Benefit:* Improves the quality of candidates that are moved forward in the hiring process.

### 3. Chatbots for Candidate and Employee Queries:

- Function:* Conversational AI for real-time interaction with candidates and employees to answer common HR-related questions.
- Benefit:* Provides instant support and frees up HR staff for more complex tasks.

#### 4. Employee Sentiment Analysis:

- *Function:* NLP to analyze employee feedback and sentiment from surveys, emails, or other communication.
- *Benefit:* Helps in understanding employee morale and addressing potential issues.

Tools that may be added in the future.

- ◆ Training and Development Programs
- ◆ Performance Management
- ◆ Workforce Analytics and Planning
- ◆ Compliance Monitoring

**To evaluate the potential impact of AI on HR-related outcomes (e.g., employee satisfaction, retention rates)**

☒ Define Objectives:

Clearly outline the specific HR-related outcomes you want to evaluate, such as employee satisfaction, retention rates, productivity, and recruitment efficiency.

☒ Identify Key Metrics:

Determine the key performance indicators (KPIs) that align with your objectives. For example, metrics for employee satisfaction might include employee surveys, feedback mechanisms, and performance reviews. Retention rates can be measured by analyzing turnover data.

The integration of Artificial Intelligence (AI) in HR processes has the potential to revolutionize various outcomes. In the realm of resume parsing and candidate screening, AI brings efficiency by swiftly analyzing large volumes of resumes and minimizing biases in the screening process. Additionally, it enhances the matching of candidate skills with job requirements.

Applicant tracking and ranking benefit from data-driven decision-making, with AI providing insights into recruitment channel performance and offering personalized job recommendations. Chatbots efficiently handle routine queries, allowing HR staff to focus on more complex tasks.

AI enhances employee sentiment analysis for proactive issue identification in HR strategies, offering significant advantages. Ethical implementation requires addressing algorithmic biases, ensuring data privacy, and emphasizing human oversight.

## 1.4 Research Questions

- 1) How can HR professionals leverage AI to improve data-driven decision-making and optimize HR practices?
- 2) How does AI technology help in automating routine and repetitive HR tasks?
- 3) How can AI technology augment HR professionals' decision-making?
- 4) How can HR professionals promote ethical and responsible AI practices in HRM?
- 5) How does collaboration between HR professionals, AI experts, and researchers contribute to integrating AI technology in HRM?

## 1.5 Significance of the Study

### **Importance of the study for HR professionals and organizations.**

*The study of implementing AI in HRM is important for HR professionals and organizations for several reasons:*

**1. Enhancing Efficiency:** AI has the potential to automate repetitive and time-consuming HR tasks, allowing HR professionals to focus on strategic initiatives and higher-value activities. Understanding how AI can improve efficiency in HR processes helps HR professionals optimize their workflow, increase productivity, and allocate resources effectively.

**2. Improving Decision Making:** AI can provide data-driven insights and predictive analytics that support decision making in areas such as talent acquisition, performance management, and workforce planning. HR professionals who understand the capabilities and limitations of AI can make more informed decisions and develop evidence-based HR strategies.

**3. Enhancing Talent Management:** AI can assist in identifying and attracting top talent, assessing candidate suitability, and supporting talent development initiatives. HR professionals who have knowledge of AI technologies can leverage them to improve talent management practices, including recruitment, onboarding, learning, and career development.

By studying and embracing AI in HRM, HR professionals and organizations can harness the potential of AI to transform HR practices, drive innovation, and achieve strategic goals while prioritizing ethical considerations and employee well-being.

### **Expected contributions to the field of HRM and AI technology.**

*The intersection of HRM and AI technology holds significant potential for contributions to both fields:*

**1. Advancing HR Practices:** The integration of AI technology in HRM can lead to advancements in various HR practices. AI algorithms can provide valuable insights into areas such as talent acquisition, employee performance, learning and development, and workforce planning. By leveraging AI technology, HR professionals can make data-driven decisions, improve efficiency, and enhance the overall effectiveness of HR practices.

#### **2. Automation and Efficiency:**

AI technology can automate routine and repetitive HR tasks, freeing up HR professionals' time to focus on more strategic and value-added activities. This automation can lead to increased efficiency, reduced manual effort, and improved productivity in HR processes.

#### **3. Improved Decision Making:**

AI technology can augment HR professionals' decision-making

analyzing vast amounts of data and providing actionable insights. AI algorithms can identify patterns, trends, and correlations in HR data, enabling HR professionals to make more informed and evidence-based decisions in areas such as talent management, performance evaluation, and succession planning.

**4. Ethical and Responsible AI Implementation:** The field of HRM can contribute to the development and implementation of ethical and responsible AI practices. HR professionals can play a crucial role in ensuring transparency, accountability, and fairness in the design, deployment, and use of AI systems in HR processes. This includes addressing privacy concerns, mitigating biases, and maintaining human oversight to ensure ethical AI practices.

**5. Knowledge Sharing and Collaboration:** The integration of AI technology in HRM requires collaboration and knowledge sharing between HR professionals, AI experts, and researchers. This collaboration can lead to the development of innovative AI solutions tailored to HR needs, as well as the exchange of best practices, challenges, and lessons learned between the fields of HRM and AI technology.

#### **Potential implications for policy-making and strategic planning in HR departments.**

*The integration of AI technology in HR departments has several potential implications for policy-making and strategic planning:*

**1. Policy Development:** The adoption of AI in HR processes may require the development of policies and guidelines that address ethical considerations, data privacy, security, and transparency. HR departments need to work closely with legal and compliance teams to ensure that policies and regulations align with the use of AI technology in HR practices.

**2. Skills and Training:** The implementation of AI technology in HR departments may necessitate the acquisition of new skills and capabilities by HR professionals. Strategic planning should involve

assessing the existing skillset within the HR department, identifying skill gaps, and designing training programs to upskill HR professionals in areas such as data analysis, AI technology, and ethical AI practices.

**3. Change Management:** Effective change management is crucial for seamless integration of AI technology in HR, encompassing communication, training, and support to ensure acceptance and success, while considering the impact on job roles, responsibilities, and organizational culture.

**4. Resource Allocation:** Strategic planning should involve assessing the resource requirements for implementing AI in HR departments. This includes budgeting for AI technologies, infrastructure, data management systems, and ongoing maintenance and support. Effective resource allocation ensures that HR departments have the necessary tools and resources to implement and sustain AI initiatives.

## 1.6 Scope and Limitations of the Study

### Boundaries of what the study will cover in terms of AI functionalities.

- ❖ Investigating the implementation of NLP in resume parsing to streamline candidate screening, saving time and improving candidate selection efficiency.
- ❖ Exploring the application of machine learning in candidate tracking and ranking to enhance the overall quality of candidates progressing through the hiring process.
- ❖ Assessing the use of Chatbots in HRM to facilitate instant communication and support, allowing HR staff to focus on more complex tasks.
- ❖ Exploring the implementation of NLP for sentiment analysis in HRM to understand employee morale, identify potential issues, and facilitate proactive measures.

### Limitations related to technology, data privacy, and organizational readiness.

Organizational data readiness signifies having high-quality data and efficient processes for extracting meaningful insights. A high level of readiness enables real-time tracking of data, while low readiness may result in a lack of awareness about the location of crucial information essential for informed decision-making. So, we must follow these steps:

- ▲ Align our Data Strategy and Business Strategy.
- ▲ Minimize and breaking down data.
- ▲ Know our Data Sources and Data Quality.
- ▲ Choosing the Right Tools for Data Collection, Management, and Data
- ▲ Analytics.
- ▲ Perform a Data Readiness Assessment or Audit

**Discussion of the anticipated challenges in research methodology.**

Research involves multiple stakeholders, from individual researchers to guides, supervisors, and defense committee members. In developing nations, the ongoing nature of research is marked by challenges in selecting topics, facing infrastructural deficiencies, financial constraints, and navigating the complexities of growth.

## 1.7 Definition of Terms

1. **AI:** Involves algorithms and models for tasks like CV and job posting evaluation, simulating human intelligence in the selection process.
2. **HRM:** Focuses on strategic workforce management, including CV screening and aligning candidate skills with job requirements for effective hiring.
3. **ML:** Subset of AI enabling systems to learn and improve performance without explicit programming; in the study, it aids in automatic improvement of matching algorithms using historical data.
4. **NLP:** Crucial for understanding and processing human language, aiding in analyzing CVs and job postings, and enhancing matching algorithm accuracy.
5. **CV Matching:** Aligns candidate's skills, qualifications, and experience with job posting requirements, optimizing the selection process.
6. **Job Posting Analysis:** Involves examining language, requirements, and qualifications in a job posting to extract key information for comparison with candidate CVs.
7. **Algorithmic Matching:** Uses algorithms, possibly based on machine learning, to analyze CVs and job postings, determining compatibility between candidates and specific job requirements.
8. **Skills Assessment:** Evaluates skills in CVs against job posting requirements, aiding in the identification of suitable candidates.
9. **Automated Screening:** Utilizes technology, possibly AI, to automatically assess and shortlist CVs based on predefined criteria, streamlining the initial hiring stages.

10. **Candidate Ranking:** Utilizes algorithms to rank candidates based on compatibility with job requirements, assisting HR in prioritizing the most promising applicants.
11. **Candidate Profiling:** Involves creating detailed profiles based on CV information for comprehensive comparison with job requirements.
12. **Job Requirement Identification:** Encompasses extracting and categorizing essential skills and qualifications needed for a specific job from corresponding job postings.
13. **Semantic Analysis:** Involves understanding word meaning and context in CVs and job postings, enhancing matching precision by considering nuanced language.
14. **Predictive Modeling:** Uses historical data to build models predicting the likelihood of success or compatibility between a candidate and a specific job.
15. **Data-driven Hiring:** Emphasizes using data, possibly from previous hiring processes, to inform and optimize the current hiring process for better decision-making.
16. **Job Fit Analysis:** Involves evaluating how well a candidate's qualifications and skills align with specific job requirements, aiding in the identification of the most suitable candidates.
17. **Recruitment Automation:** Refers to using technology, including AI and machine learning, to automate various recruitment process aspects, enhancing efficiency and accuracy.

## 1.8 Structure of the Study

### Outline of the subsequent chapters and their contents.

#### Chapter 1: Introduction

The introduction provides a comprehensive view of the research problem's significance, emphasizing its relevance. It introduces the study's purpose, objectives, research questions, hypotheses, and methodology, offering a roadmap for subsequent chapters.

#### Chapter 2: Literature Review

The literature review explores relevant existing studies, identifying key theories and concepts while analyzing gaps in current knowledge. It establishes the theoretical framework and concludes by summarizing key findings from the literature.

#### Chapter 3: System Analysis

The system analysis delves into current CV-job posting matching processes, detailing necessary functionalities, and acknowledging challenges. It introduces proposed system enhancements, outlining criteria for evaluating effectiveness.

**Brief introduction to the methodology, analysis, and conclusion sections.**

#### Methodology Overview:

The methodology integrates web scraping and APIs for data collection, followed by rigorous preprocessing involving cleaning, standardization, and text conversion.

Information extraction utilizes NLP to discern keywords and skills. Machine learning, employing decision trees and neural networks, is applied for precise resume analysis, with system training on extensive datasets.

Storage involves MySQL or PostgreSQL for secure data management, accessible through a user-friendly web interface.

Predictive analytics identifies turnover potential, guiding retention strategies based on performance data. The technological backbone relies on Python, integrating machine learning for accurate job matching and comprehensive resume analysis.

# Introduction



CH. 1

**Analysis:** In-depth analysis employs NLP to extract key information from job postings, enhancing the understanding of relevant skills and keywords. Machine learning algorithms, including decision trees and neural networks, contribute to thorough resume analysis. Storage in MySQL or PostgreSQL ensures secure data management, accessible through a web-based interface. Predictive analytics guides retention strategies based on performance data. Python and machine learning form the technological backbone for precise job matching and comprehensive resume analysis.

**Conclusion:** The study employs an integrated methodology, leveraging NLP and machine learning for accurate job matching and insightful resume analysis, emphasizing efficient data management. Python and machine learning algorithms form the core technological foundation, showcasing a commitment to precision in job postings and resume analysis.

## 1.9 Summary

Chapter one of the AI-Enhanced Human Resource Management System research project provides an overview of the research problem and its significance, introduces the purpose and objectives of the study, outlines the research questions and hypotheses, briefly mentions the methodology used for data collection and analysis, and previews the subsequent chapters.

The chapter begins by explaining traditional HR management practices and the evolution of HRM with the advent of technology. It then discusses current trends in AI and their impact on HRM,

identifying the challenges faced by HR departments and the gap in current HR systems that AI could bridge. The chapter also explores how AI can address specific HR inefficiencies and outlines the specific objectives of the study, which include determining the benefits of integrating AI into HR systems and identifying the key functions AI can serve in AI-EHRMS.

The chapter then discusses the research questions, which aim to evaluate the potential impact of AI on HR-related outcomes. It also highlights the significance of the study for HR professionals and organizations, including its expected contributions to the field of HRM and AI technology, as well as its potential implications for policy-making and strategic planning in HR departments. The chapter concludes by discussing the anticipated challenges in research methodology and the scope and limitations of the study, including the boundaries of what the study will cover in terms of AI functionalities.

It had provided definitions of key terms related to the study and had outlined the subsequent chapters and their contents. Which had helped to establish a common understanding of the key concepts and terminology used throughout the research project and provide a roadmap for the subsequent chapters. Moving forward, Chapter two will survey existing literature related to the study's focus.

## 2.1 Overview of Current Literature

### Introduction

Given this thorough foundation laid in Chapter 1, the subsequent chapter, Chapter 2 (Literature Review), is poised to delve into existing research, providing a deeper understanding of the context and building upon the groundwork established in the introductory chapter.

The landscape of Human Resource Management (HRM) has undergone significant transformations in recent years, propelled by the integration of Artificial Intelligence (AI). This section provides a panoramic overview of the existing research and literature in the dynamic field of AI-enhanced HR systems. Through a meticulous survey of key studies and identification of major themes, this literature review aims to illuminate the evolution of HR technology, with a particular focus on the advancements brought about by AI.

The exploration of AI in HRM marks a pivotal juncture where traditional practices converge with cutting-edge technologies. As organizations strive for efficiency, accuracy, and strategic talent management, the integration of AI emerges as a catalyst for innovation in HR processes.

Key studies in this domain have dissected the transformative impact of AI, shedding light on its implications for organizational dynamics, workforce management, and the overarching HR landscape.

Major themes that emerge from the existing literature include the theoretical underpinnings that guide the assimilation of AI in HRM, the nuanced technological advancements that reshape HR processes, and the practical applications of AI in critical HR functions like recruitment, talent acquisition, employee engagement, and retention. This literature review embarks on a journey through these thematic domains, offering insights into the theoretical foundations, technological landscapes, and real-world applications of AI in the realm of HRM.

# CH.2 Literature Review



The evolution of HR technology, as documented in the literature, underscores a paradigm shift from traditional approaches to a more data-driven and intelligent model. The emergence of machine learning, natural language processing, and data analytics as integral components of HRM signifies a departure from conventional methodologies. This review endeavors to encapsulate this evolutionary trajectory, positioning AI as a central protagonist in the narrative of modern HR practices.

As we navigate through the pages of existing research, it becomes evident that AI in HRM is not a mere technological upgrade but a strategic enabler with profound implications for organizational success. By critically examining the contours of this evolving landscape, we set the stage for a more in-depth exploration of the theoretical foundations, technological advancements, and practical applications that characterize the symbiosis of AI and HRM.

## 2.2 Theoretical Foundations

### **Exploring theories and summary of 5 Research Papers related to AI & HRM**

*In (1)* This research paper explores the impact of Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) on Human Resource Management (HRM). The study analyzes 247 Scopus-indexed documents using bibliometric analysis to identify research trends, key themes, and future research directions related to AI-HRM. The paper highlights the potential of AI, ML, and NLP to improve HRM processes such as resource allocation, talent acquisition, and training and development.

The benefits of these techniques include improved efficiency, service delivery, standardization, and

empowerment of managers. The paper provides valuable insights into the current state of research on AI-HRM and identifies areas that require additional research.

The limitations of this paper include the lack of a specific start date for the Scopus search, which may have excluded some relevant studies. Additionally, the study does not address the potential ethical concerns surrounding the use of AI in HRM, and the paper does not provide a comprehensive analysis of the impact of AI, ML, and NLP on HRM processes. Finally, the paper does not provide a detailed analysis of the challenges associated with implementing AI, ML, and NLP in HRM.

*In (2)* This research paper investigates the impact of AI, ML, and NLP on HRM practices, specifically recruitment and selection in IT companies in Chennai. The study used literature review and survey research methods to collect data.

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The benefits of using these techniques include increased efficiency, accuracy, and reduced bias in the recruitment and selection process. Additionally, the study found that these techniques can save time and costs and improve the candidate experience.

However, the limitations of this study include a small sample size, limited generalizability, and the potential for technical errors in the AI and ML algorithms. Additionally, the study did not address the ethical concerns surrounding the use of AI in HRM practices, such as privacy and discrimination issues. Finally, the study did not explore the long-term effects of using these techniques on employee retention and job satisfaction.

*In (3)* This research paper proposes an automated Machine Learning-based model to enhance the HRM process. The model uses techniques of AI, ML, and NLP to classify resumes into different categories and recommend the most suitable candidate's profile to HR. The model captures resume insights and semantics and maps them to the job description to understand if the candidate would be able to do the job. The model can take CVs in CSV format but can be enhanced to take .doc or .pdf formats using the "texttract" library.

The benefits of this approach include easing the task of finding suitable candidates for open roles, reducing the time and resources required for manual resume screening, and customizing the system for specific job requirements and industries. The model yields an accuracy of 78.53% with LinearSVM classifier.

The limitations of the model design include the need for more data to train the model, the current limitation of the model to take CVs in CSV format only, and the need for fine-tuning to ensure minimal information loss. The model's performance may enhance by utilizing deep learning models like Convolutional Neural Network, Recurrent Neural Network, or Long-Short Term Memory and others. The model's accuracy may also be affected by the quality of the job description and the relevance of the keywords used. Involving domain experts like HR professionals may help to improve the model iteratively.

*In (4)* This research paper explores the use of AI, ML, and NLP techniques to enhance the HRM process. The study focuses on job matching and uses stochastic gradient descent and an algorithm called Hiring History to review people's previous hiring settings.

The benefits of these techniques include better candidate-employer matches, improved hiring processes, and increased efficiency in HRM. The model is currently being used by the Department of Employment, Thailand.

The limitations of this study include the difficulty in obtaining a vast dataset of personal information about people's work, the potential for inaccurate the potential

# CH.2 Literature Review



for inaccurate information from candidates, and the possibility of suggesting former jobs that are no longer available. Future work will focus on adding more attributes to the model and gathering data from different companies to improve the hiring process. Financial support for this research was provided by Depth First Co, Ltd. (Thailand).

*In (5)* This research paper focuses on using AI, ML, and NLP techniques to evaluate CVs in the HRM process.

- The study uses data mining and text mining to extract structured information from unstructured or semi-structured natural language. - The extracted data is then fed to NLP tools like spaCy for text categorization.
- PDF Miner is used to parse text from PDF files, and the parsed result is cleaned using RegEx patterns to remove unwanted text and special characters.
- The study requires at least a few hundred examples for both training and evaluation to train a model from scratch.
- The benefits of using these techniques include automating the preselection and assessment of candidates, replacing tedious manual processing with accurate and effective evaluation results.
- The study aims to enhance the HRM process in general by providing a more efficient and effective way of evaluating CVs.
- The use of AI, ML, and NLP techniques can help reduce bias in the recruitment process and improve the quality of candidate selection.
- The limitations of the study include the need for a large amount of data to train the model effectively.
- The model may not perform well on certain types of text, such as legal text, if it is trained on a different type of text, such as romantic novels.
- The study also highlights the importance of evaluating the model on data that was not used in the training process to ensure that it is generalizing well.
- The extraction of structured information from unstructured or semi-structured natural language can be challenging and may not always be accurate.
- The study also notes that the use of these techniques does not eliminate bias in the recruitment process, as biases can still be present in the data used to train the model.
- Finally, the study emphasizes the need for further research to improve the accuracy and effectiveness of these techniques in evaluating CVs.

# CH.2 Literature Review



## Theoretical foundations discussion

The theoretical foundations underpinning the transformation of Human Resource Management (HRM) through the integration of Artificial Intelligence (AI), Natural Language Processing (NLP), and Machine Learning (ML) are evident in the evolution from traditional HR practices to automated, efficient, and data-driven processes. The exploration of the discussed research papers provides valuable insights into how these technologies have reshaped HRM tasks and practices, offering a glimpse into the theoretical underpinnings that have fueled this transformative journey.

### Evolution from Traditional to Automated Practices:

The theoretical foundation lies in recognizing the shift from manual, time-intensive HRM tasks to automated processes driven by AI, NLP, and ML. The first research paper emphasizes the potential of these technologies in improving resource allocation, talent acquisition, and training and development. This shift is grounded in the theoretical premise that automation can enhance efficiency, standardize processes, and empower managerial decision-making.

### Semantic Understanding and Matching:

The third research paper introduces a Machine Learning-based model designed to automate the resume recommendation system. The theoretical foundation here involves leveraging AI, ML, and NLP to not only categorize resumes but also understand the semantics and match candidates to job descriptions. The essence lies in the theoretical framework that semantic understanding enables a more nuanced and accurate candidate-job fit, contributing to improved HRM processes.

### Enhancing Recruitment and Selection Processes:

The second and fourth research papers delve into the impact of AI, ML, and NLP on recruitment and selection processes. The theoretical foundation here suggests that these technologies contribute to increased efficiency, accuracy, and reduced bias in candidate selection. The utilization of stochastic gradient descent and algorithms like Hiring History aligns with the theoretical premise that such techniques can lead to better candidate-employer matches and streamlined hiring processes.

### Automating CV Evaluation:

The fifth research paper extends the theoretical foundations by focusing on the evaluation of CVs through AI, ML, and NLP. The theoretical underpinning involves automating preselection and assessment, replacing manual processes with effective and unbiased evaluation results.

# CH.2 Literature Review



The study acknowledges the importance of data quantity, model training, and the need for further research to enhance the accuracy and effectiveness of these techniques.

## ☒ Performance Analytics for Decision-Making:

Across all papers, there is a common thread highlighting the use of AI, NLP, and ML for data-driven decision-making. The theoretical foundation here suggests that performance analytics derived from these technologies provide valuable insights for HR professionals and organizational leaders, enabling informed and strategic decision-making.

In summary, Theoretical foundations of AI-enhanced HRM focus on transitioning to automated practices, leveraging semantic understanding, and providing efficiency and strategic insights. However, addressing limitations and challenges is essential for fully harnessing the transformative potential of AI in HRM.

## 2.3 Technological Advancements in HRM

In today's dynamic business landscape, technology plays a pivotal role in reshaping Human Resource Management (HRM). HR technology solutions, driven by trends such as big data utilization, mobile app integration, and social media influence, are revolutionizing traditional HR practices. The power of big data allows HR professionals to gain valuable insights, assess potential employees, and optimize risk management. Mobile apps have become integral, providing convenient access to HR functions, especially with the rising popularity of remote work. Social media platforms, like LinkedIn, offer effective avenues for recruitment and employee engagement.

### ❖ Artificial Intelligence in HRM:

Artificial intelligence (AI) is increasingly vital in human resource management (HRM), revolutionizing practices by automating tasks, improving recruitment, and providing efficiency. The integration of AI in HRM enables organizations to increase efficiency, gain insights into employee engagement, and automate the selection process. However, addressing limitations and challenges is essential for fully harnessing the transformative potential of AI in HRM. This literature review provides insights into the current landscape of AI in HRM and its opportunities.

### ❖ Machine Learning in HRM Processes:

Machine learning has a significant impact on the HR industry, revolutionizing areas such as predictive analytics, talent acquisition, employee engagement, performance management, and training and development. AI algorithms analyze vast amounts of HR data, enabling better data-centric decisions and streamlined processes.

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In talent acquisition and management, ML algorithms analyze resumes, job descriptions, and applicant data, saving time and resources. Additionally, NLP techniques and chatbots assist HR functions, allowing professionals to focus on strategic projects.

## ⊕ Natural Language Processing (NLP) in HRM:

HRM uses NLP techniques and tools to analyze employee and candidate data such as emails, resumes, feedback, and social media content. NLP algorithms take the unstructured text data and analyze it to extract useful information, including sentiment analysis, personality traits, competency, and areas of interest.

This can assist HR teams in decision-making related to hiring, talent retention, and improving employee satisfaction. NLP can also automate some HR processes, such as resume screening, candidate ranking, and employee feedback analysis. In summary, NLP is a valuable tool for HR teams to understand better and manage their employees and candidates.

## ⊕ Data Analytics in HRM:

Data analytics is crucial in HR decision-making, providing insights into workforce planning, talent acquisition, and employee engagement. By leveraging HR analytics, organizations can make informed decisions that positively impact their overall strategic objectives.

## ⊕ Employee Engagement and AI:

AI tools play a vital role in enhancing employee engagement through personalized learning and development initiatives, feedback mechanisms, and fostering positive workplace cultures. These technologies contribute to creating a more dynamic and supportive work environment.

## ⊕ Challenges and Considerations:

While adopting AI in HRM brings numerous benefits, it also presents challenges and ethical considerations. These may include biases in algorithms and concerns about privacy. Organizations need to proactively address these challenges to ensure responsible AI use.

## ⊕ Case Studies or Examples:

Real-world examples of organizations successfully implementing AI in HRM, such as improved recruitment efficiency or enhanced employee engagement, provide tangible evidence of the benefits of technology adoption.

## ⊕ Conclusion:

The integration of AI, machine learning, NLP, and data analytics in HRM transforms HR processes and adapts to the evolving needs of the workforce, shaping a more dynamic and adaptive workplace environment.

## 2.4 AI in Recruitment and Talent Acquisition

The reviewed (literature) research papers collectively shed light on the challenges in traditional Human Resource Management (HRM) systems and how the application of Artificial Intelligence (AI) addresses these issues, particularly in the realm of recruitment and talent acquisition. The focus areas include automated resume screening, predictive analytics for candidate selection, and addressing biases in the hiring process.

### **Automated Resume Screening:**

Traditional HRM systems often face challenges in manually screening a large volume of resumes, a time-consuming process prone to errors and subjectivity. The third research paper proposes an AI-based model that utilizes Machine Learning (ML) and Natural Language Processing (NLP) to automate resume screening. This approach aims to ease the task of finding suitable candidates for open roles, reduce time and resource requirements, and customize the system for specific job requirements and industries. The model's accuracy of 78.53% with a LinearSVM classifier demonstrates the potential of AI in improving the efficiency and accuracy of resume screening.

### **Predictive Analytics for Candidate Selection:**

The second research paper, focusing on AI's impact on recruitment and selection in IT companies, indicates that AI, ML, and NLP techniques can increase efficiency, accuracy, and reduce bias in the candidate selection process. However, the study acknowledges limitations, including a small sample size and the potential for technical errors in algorithms. The challenge of assessing whether AI truly improves hiring accuracy and reduces bias is complex, as the success depends on the quality of algorithms, data, and ethical considerations.

### **Enhancing Diversity and Reducing Biases in Hiring:**

The second and fifth research papers highlight the potential benefits of AI, ML, and NLP techniques in reducing biases in the recruitment process, emphasizing the need for further research to explore the long-term effects on employee retention and job satisfaction, and the importance of evaluating the model on diverse data to ensure generalizability. These technologies aim to provide a more efficient and effective way of evaluating CVs, contributing to reducing biases in candidate selection.

In summary, AI has potential in addressing challenges in traditional HRM systems, especially in recruitment and talent acquisition processes. Ongoing research is necessary to refine these AI applications, ensuring they meet ethical standards, address potential biases, and contribute to fair and accurate candidate selection.

## 2.5 AI in Employee Engagement and Retention

AI tools and platforms play a crucial role in employee engagement and retention by offering innovative solutions that enhance various aspects of the employee experience. Here are several ways in which AI contributes to employee engagement and retention:

### ▽ Personalized Learning and Development:

- AI-powered learning platforms can analyze employee performance, identify skill gaps, and recommend personalized training programs.
- Personalized learning experiences contribute to employee satisfaction and career development, leading to higher retention rates.

### ▽ Predictive Analytics for Attrition Risk:

- AI algorithms can analyze various data points, including employee performance, feedback, and behavior, to predict the likelihood of an employee leaving the organization.
- Early identification of attrition risks allows HR teams to implement targeted retention strategies.

### ▽ Automated Onboarding Processes:

- AI streamlines the onboarding process by automating administrative tasks, allowing HR teams to focus on creating engaging onboarding experiences.
- Smooth onboarding experiences positively impact employee engagement from the start of their tenure.

### ▽ Employee Feedback and Sentiment Analysis:

- AI tools can collect and analyze employee feedback from various sources, including surveys, social platforms, and communication channels.
- Sentiment analysis helps organizations understand employee satisfaction levels, enabling them to address concerns and improve engagement.

### ▽ Chatbots for Employee Support:

- AI-powered chatbots provide instant support to employees, answering queries related to HR policies, benefits, and other routine matters.
- Quick and efficient support contributes to a positive employee experience and can improve overall job satisfaction.

### ▽ Performance Management and Recognition:

- AI can assist in continuous performance management by providing real-time feedback and performance analytics.
- Automated recognition programs powered by AI can identify and reward employees for their achievements, boosting morale and engagement.

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## ▼ Workforce Planning and Optimization:

- AI-driven workforce planning tools help organizations optimize their talent pool by identifying the right mix of skills and roles.
- Strategic workforce planning contributes to a more engaged and fulfilled workforce.

## ▼ Wellness and Work-Life Balance:

- AI tools can monitor employee workloads, stress levels, and other well-being indicators.
- By promoting a healthy work-life balance, organizations can enhance employee satisfaction and reduce burnout, contributing to retention.

## ▼ Diversity and Inclusion Initiatives:

- AI can help identify and eliminate biases in hiring and performance evaluations, promoting a more inclusive workplace.
- Inclusive environments contribute to employee satisfaction and reduce turnover.

## ▼ Employee Engagement Surveys and Actionable Insights:

- AI-powered survey tools can analyze survey responses to provide actionable insights for HR teams.
- Proactive measures based on these insights contribute to improved engagement and retention strategies.

In summary, AI tools and platforms contribute to employee engagement and retention by providing data-driven insights, automating processes, and creating personalized experiences that cater to the individual needs and preferences of employees. The key is to leverage AI in a thoughtful and ethical manner to enhance the overall employee experience and contribute to a positive workplace culture. For an example of these tools: Glint, now a part of LinkedIn, utilizes AI to gather and analyze employee feedback, providing insights into engagement and retention.

## 2.6 Case Studies and Real-World Applications

As organizations increasingly embrace digital transformation, HRM processes have evolved with the integration of innovative technologies, such as AI, ML and NLP.

This discussion delves into three real-world applications that have redefined HRM by automating processes, enhancing accuracy, and leveraging advanced technologies. The aim is to compare these applications, highlighting their functions, goals, benefits, limitations, and challenges.

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Table 2.1 Comparison of AI-Enhanced HRM Applications

Nom	Technology Used	Functions	Functionalities	Objectives	Benefits	Limitations
JobLeads Website	AI for automating the recruitment process, NLP for resume review, ML for personalized job recommendations	Job search, headhunters, resume review, career coaching	Consolidates job listings, provides tools for job seekers, streamlines job search	Help job seekers land better jobs faster, focus on AI tools for optimizing job search and recruitment process	More relevant job opportunities, tailored feedback, personalized resume tools, digital coaching, enhanced user experience	Specific limitations not mentioned, potential challenges in AI implementation such as biases and lack of human touch
Bayt.com Website	AI for automating the recruitment process, ML for matching job seekers with relevant opportunities, NLP for resume analysis and job description generation	Job search, resume review, AI-powered hiring tools for employers	Provides job search platform, tailored feedback for job seekers, AI-powered job description generation, and hiring tools for employers	Facilitate job search process for job seekers, provide AI-powered hiring tools for employers to enhance HRM process	More relevant job opportunities, tailored feedback, AI-powered job description generation, enhanced accuracy and efficiency of HRM process	Specific limitations not mentioned, potential challenges in AI implementation such as biases and complex HRM processes
Glassdoor: Jobs & Community App	The app likely applies AI for personalized job recommendations, NLP for analyzing company reviews and interview insights, and ML for tracking job application trends and providing salary information.	Job search, company reviews, salary information, interview insights, and job application tracking. The app likely applies AI for personalized job recommendations, NLP for analyzing company reviews and interview insights, and ML for tracking job application trends and providing salary information.	Provides job search, company reviews, salary insights, interview experiences, and job application tracking. The app aims to offer a comprehensive platform for job seekers to make informed career decisions.	The app's objective is to empower job seekers with personalized job recommendations, insights into company culture, and salary information. The focus on AI tools may aim to enhance the accuracy of job recommendations and provide tailored insights for users.	The benefits of using AI in the app may include personalized job recommendations, tailored company reviews and interview insights, and accurate salary information. AI can enhance the user experience by providing relevant and personalized content to aid in career decision-making.	Specific limitations related to AI implementation are not explicitly mentioned in the search results. However, potential challenges in AI implementation could include biases in personalized recommendations and limitations in fully automating complex HRM processes.

## Description:

### 1. JobLeads Website:

- Website Information:** The website is JobLeads, which offers job search, headhunters, resume review, and career coaching services.

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- **Functions and Applied Technologies:** The functions of the website include job search, headhunters, resume review, and career coaching. These functions are likely supported by various technologies, including AI for automating the recruitment process, NLP for resume review, and ML for personalized job recommendations based on user behavior and preferences.
- **Functionalities:** JobLeads empowers job seekers by streamlining their search for the ideal career opportunity and providing them with all the tools necessary to land a better job faster. It consolidates job listings from numerous sources, such as job sites, company career pages, and vacancies managed by headhunters, eliminating the need for time-consuming, scattered searches.
- **Objectives:** The primary objective of JobLeads is to help job seekers land a better job faster. The focus on AI tools is likely to optimize the job search funnel, provide tailored guidance, and automate certain aspects of the recruitment process.
- **Benefits and AI Usage:** The benefits of using AI on this website may include more relevant job opportunities, tailored feedback on job searches, personalized resume tools, and digital coaching offerings to effectively turn more interviews into job offers. AI can enhance the user experience by providing personalized recommendations and streamlining the job search process.
- **Limitations/Challenges:** The limitations found in this website that they couldn't implement with AI yet are not explicitly mentioned in the search results. However, common limitations in AI implementation could include potential biases in automated processes, lack of human touch in certain aspects of career coaching, and challenges in fully automating complex HRM processes.

## 2. Bayt.com Website:

- **Website Information:** The website is Bayt.com, an online job portal that connects job seekers with employers in the Middle East and North Africa.
- **Functions and Applied Technologies:** The functions of the website include job search, resume review, and AI-powered hiring tools for employers. Bayt.com likely applies AI for automating the recruitment process, ML for matching job seekers with relevant opportunities, and NLP for resume analysis and job description generation.

**Functionalities:** Bayt.com provides job seekers with a platform to search for job opportunities, receive tailored feedback on job searches, and access AI-powered job description generation. For employers, it offers AI-powered hiring tools to streamline the recruitment process.

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- **Objectives:** The primary objective of Bayt.com is to facilitate the job search process for job seekers and provide AI-powered hiring tools for employers to enhance the accuracy and efficiency of the HRM process.
- **Benefits and AI Usage:** The benefits of using AI on this website may include more relevant job opportunities for job seekers, tailored feedback on job searches, and AI-powered job description generation for employers. AI can enhance the accuracy and efficiency of the HRM process by automating certain tasks and providing personalized recommendations.
- **Limitations:** The limitations found in this website that they couldn't implement with AI yet are not explicitly mentioned in the search results. However, common limitations in AI implementation could include potential biases in automated processes and challenges in fully automating complex HRM processes. Overall, Bayt.com appears to leverage AI, ML, and NLP to improve the accuracy and efficiency of the job search and recruitment process, providing users with personalized tools and guidance to enhance their job search experience.

### 3. Glassdoor: Jobs & Community App:

- **App Information:** The app in question is Glassdoor: Jobs & Community, a platform that provides job seekers with access to job listings, company reviews, salary information, and interview insights.
- **Functions and Applied Technologies:** The app likely applies AI for personalized job recommendations, NLP for analyzing company reviews and interview insights, and ML for tracking job application trends and providing salary information.
- **Functionalities:** Glassdoor offers a wide range of functionalities, including job search, access to company reviews, insights into interview experiences, and tracking of job applications. The app aims to provide a comprehensive platform for job seekers to make informed career decisions.
- **Objectives:** The primary objective of Glassdoor is to empower job seekers with personalized job recommendations, insights into company culture, and accurate salary information. The focus on AI tools may aim to enhance the accuracy of job recommendations and provide tailored insights for users.
- **Benefits and AI Usage:** The benefits of using AI in the app may include personalized job recommendations, tailored company reviews and interview insights, and accurate salary information. AI can enhance the user experience by providing relevant and personalized content to aid in career decision-making.

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- Limitations:** Specific limitations related to AI implementation are not explicitly mentioned in the search results. However, potential challenges in AI implementation could include biases in personalized recommendations and limitations in fully automating complex HRM processes.

## 2.7 Gaps in Existing Research

**Table 2.2 Comparative Analysis of AI Techniques Used**

Platform	AI Techniques Used	Advantages	Disadvantages
Glassdoor	Personalized job recommendations, NLP for analyzing company reviews and interview insights, ML for tracking job application trends and providing salary information	Provides personalized job recommendations, insights into company culture, accurate salary information	Specific limitations related to AI implementation not explicitly mentioned
JobLeads	AI for automating the recruitment process, NLP for resume review, ML for personalized job recommendations	Streamlines job search, provides tailored feedback, automates recruitment process	Specific limitations related to AI implementation not explicitly mentioned
Bayt.com	AI for automating the recruitment process, ML for matching job seekers with relevant opportunities, NLP for resume analysis and job description generation	Facilitates job search process, provides AI-powered hiring tools, enhances accuracy and efficiency of HRM process	Specific limitations related to AI implementation not explicitly mentioned
HRBotix	HRBotix system incorporates AI techniques to streamline HR processes. It automates recruitment tasks, leverages advanced technology and NLP for job posting analysis, and utilizes ML algorithms for resume matching. Additionally, it features chatbots for queries and employs AI for employee sentiment analysis. Overall, HRBotix enhances efficiency and improves candidate-job alignment in HR operations.	Efficiency boost by automating recruitment, leveraging advanced tech for job analysis, and ensuring precise resume matching.  Instant support through chatbots and insightful sentiment analysis contribute to operational optimization, aligning candidates with jobs effectively.	It will reduce the disadvantages of other HRM systems

# CH.2 Literature Review



**Table 2.3 Key Functions AI Can Serve in HRBotix System**

Function	AI Technique	Benefit
Resume Parsing and Candidate Screening	NLP	Saves time by quickly identifying qualified candidates
Applicant Tracking and Ranking	ML	Improves the quality of candidates in the hiring process
Chatbots for Candidate and Employee Queries	Conversational AI	Provides instant support and frees up HR staff
Employee Sentiment Analysis	NLP	Helps in understanding employee morale and addressing potential issues

## Comparative Analysis: (Evaluation of AI Techniques)

- ▽ All platforms and the HRBotix system leverage a combination of AI techniques such as NLP, ML, and Conversational AI to enhance HRM processes.
- ▽ Each platform and the HRBotix system offer unique advantages in terms of personalized job recommendations, streamlined job search, and improved candidate selection processes.
- ▽ The specific limitations related to AI implementation are not explicitly outlined for the platforms; but the HRBotix system implement AI very clearly depending on the table -above- of Key Functions AI Can Serve in HRBotix System.

In conclusion, the comparative analysis reveals that each platform and the HRBotix system leverage AI techniques to enhance HRM processes, offering unique advantages. However, the specific limitations related to AI implementation are not explicitly outlined. Therefore, this research should focus on identifying and addressing these limitations to further enhance the effectiveness of AI in HRM systems.

Based on the evidence and reference from the previous descriptions, it is challenging to definitively determine which AI technique is better without specific details on the performance and implementation of these techniques in the respective platforms and the HRBotix system. Each platform and the HRBotix system leverage a combination of AI, NLP, and ML to enhance HRM processes, offering unique advantages.

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Based on the evidence and reference from the previous descriptions, it is challenging to definitively determine which AI technique is better without specific details on the performance and implementation of these techniques in the respective platforms and the HRBotix system. Each platform and the HRBotix system leverage a combination of AI, NLP, and ML to enhance HRM processes, offering unique advantages.

Despite this, we see from my point of view that the HRBotix system will succeed in integrating all the artificial intelligence techniques with HRM systems and will overcome the limitations in previous systems, which we also studied in the research papers attached to this study. We see that the basic functions that it will add, which are present in the table above, will distinguish it from the rest of the HRM systems that failed in covering the largest number of AI techniques with limitations.

To establish which technique is better, a detailed performance evaluation and comparison of the platforms and the HRBotix system would be necessary. This evaluation should consider factors such as the accuracy of personalized recommendations, efficiency in streamlining the job search, and the effectiveness of candidate selection processes. Additionally, addressing the specific limitations related to AI implementation and potential challenges would be crucial in determining the overall effectiveness of the AI techniques used in these platforms and the HRBotix system.

## 2.8 Theoretical and Practical Implications

The exploration of research papers in the field of AI-enhanced Human Resource Management (HRM) reveals significant theoretical and practical implications that shape the future of HRM. The implications span various aspects, reflecting both the potential benefits and challenges associated with the integration of Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) in HRM processes.

### 1. Evolution of HRM Processes:

The theoretical underpinning of these studies indicates a transformative shift in traditional HRM processes. AI, ML, and NLP technologies are not merely supplementary but act as catalysts for redefining resource allocation, talent acquisition, and training and development within organizations. The practical implication is a more efficient, standardized, and streamlined HRM framework.

### 2. Enhanced Efficiency and Standardization:

The integration of AI technologies in HRM, as highlighted in the research papers, leads to improved efficiency and service delivery. Automation of tasks such as resume screening, job matching, and candidate evaluation results in faster and

# CH.2 Literature Review



standardized processes. The theoretical implication suggests a paradigm shift towards data-driven decision-making in HRM.

## 3. Advancements in Recruitment and Selection:

The practical implications derived from the research papers showcase how AI, ML, and NLP positively impact recruitment and selection processes. The ability to increase efficiency, accuracy, and reduce biases in candidate selection aligns with the theoretical evolution of HRM towards more objective and data-driven practices.

## 4. Personalization and Customization:

The research on AI-based resume recommendation systems underscores the theoretical emphasis on personalization. AI facilitates the customization of HRM processes, tailoring recommendations and assessments based on individual candidate profiles and job requirements. This reflects a move towards more personalized and candidate-centric HRM practices.

## 5. Challenges and Ethical Considerations:

Theoretical discussions regarding the limitations and ethical concerns associated with AI in HRM highlight the importance of addressing potential biases, privacy issues, and discrimination. The practical implication is a need for ongoing research and the development of ethical frameworks to guide the responsible implementation of AI technologies in HRM.

## 6. Future Trends and Predictions:

The future of HRM with AI integration is envisioned as a trajectory towards greater automation, predictive analytics, and enhanced decision support. The studies point towards the potential for AI to continuously evolve, addressing current limitations and expanding its role in HRM. Future trends may include improved algorithms, increased data compatibility, and enhanced user interfaces for better AI-HRM integration.

## 7. Role of AI in HRM:

From the perspective of future development, AI is poised to play a pivotal role in HRM by further augmenting decision-making, automating routine tasks, and providing deeper insights into workforce dynamics. The practical implication is a dynamic HRM landscape that embraces technological advancements to adapt to changing organizational needs and workforce expectations.

In conclusion, the theoretical and practical implications derived from the reviewed literature suggest a promising future for HRM with AI integration, offering new possibilities and enhancing the overall effectiveness of human resource processes. However, addressing challenges and ethical considerations remains crucial for the responsible development and deployment of AI in HRM.

# CH.2 Literature Review



## 2.9 Summary

The literature review provides a comprehensive overview of existing research and literature related to AI-enhanced HRM systems. It delves into the evolution of HRM with the advent of technology, the impact of current trends in AI on HRM, and the challenges faced by HR departments. The review also outlines the significance of the study, its objectives, research questions, and the scope and limitations of the research. Furthermore, it establishes a shared understanding of key concepts and terminology used throughout the research project and provides a roadmap for subsequent chapters.

The literature review sets the stage for the research by providing a deeper understanding of the context and building upon the groundwork established in the introductory chapter. It identifies key theories, concepts, and research findings, analyzes gaps in current knowledge, and establishes the theoretical framework for the research. The review also acknowledges the challenges in research methodology and carefully delineates the scope and limitations of the study, defining the boundaries within which the research will operate concerning AI functionalities.

Moving forward, Chapter three "System Analysis and Design".



# CH.3 ANALYSIS & DESIGN



## 3.1 Introduction

In the Analysis & Design chapter, we will delve into the analysis phase of the system development process, where we will identify the main functions of the system, determine functional and non-functional requirements, and establish a solid foundation for the design phase.

This chapter will also introduce the sources of our dataset and guide us through the process of working with it effectively. As we progress, we will identify the main models that determine the interaction between different objects, providing a comprehensive understanding of the system's structure and behavior.

By the end of this chapter, we will have a clear understanding of the system's requirements and objectives, paving the way for the design phase, where we will translate these requirements into a practical and efficient system.

## 3.2 Problem Description

Traditional recruitment grapples with geographic constraints, excessive paperwork, and high print media costs, hindering job seekers' access to opportunities, even post-technological advancements.

In AI-EHRMS, machine learning faces challenges in adaptability, inclusivity, and biases, affecting resume recommendations, job matching, and CV evaluations, hindering efficient HR recruitment processes.

Format restrictions and data scarcity impede diverse resume processing, while potential bias poses a risk to fair candidate assessments, hindering the effectiveness of machine learning models.

Historic challenges in ranking candidates based on job requirements and past hires persist. Overcoming these challenges is vital for enhancing candidate quality in HR systems and ensuring fair recruitment practices with evolving technology.

## 3.3 Scope

The study explores AI applications in HR, focusing on NLP for streamlined candidate screening, machine learning for candidate tracking, and the use of Chatbots to enhance HR communication efficiency.

Implementation involves leveraging NLP for sentiment analysis in HRM to understand employee morale and machine learning for tracking and ranking candidates, ultimately improving the overall quality of candidates during the hiring process.

To overcome limitations, the study emphasizes organizational data readiness. This involves aligning data and business strategies, understanding data sources, and selecting the right tools for data collection and analytics to enable informed decision-making.

Anticipated challenges in research methodology include topic selection difficulties, infrastructural deficiencies, financial constraints, and complexities, particularly in developing nations. The research involves multiple stakeholders, making it crucial to navigate and address multifaceted challenges.

## 3.4 Proposed Solution

Implement AI in resume screening and candidate tracking to overcome traditional recruitment challenges, reducing paperwork, and enhancing efficiency in candidate selection through NLP and machine learning.

Focus on refining machine learning models to improve adaptability and inclusivity, mitigating biases in resume recommendations and job matching. Address format restrictions and data scarcity to ensure widespread effectiveness.

Ensure organizational data readiness by aligning strategies, minimizing data, and selecting the right tools.

Conduct a thorough data readiness assessment to facilitate real-time tracking and informed decision-making.

AI-driven solutions enhance employee engagement and retention through personalized learning, predictive analytics, automated onboarding, chatbot support, and real-time performance management, prioritizing continuous refinement and ethical considerations.

## 3.5 Data Gathering

### 1. CV Dataset

Dataset Source:

- Kaggle dataset with 46 columns, 83,439 rows.

Description:

- Focus on software developers' employment, education, languages, and compensation.

Dataset Attributes:

- 46 columns covering employment, education, languages, compensation.
- Tools, technologies, and demographics

# CH.3 ANALYSIS & DESIGN



included for comprehensive insights.

## Dataset Size and Structure:

83,439 rows, 46 columns, 29.3+ MB memory usage. Mix of numerical and categorical data enriches analytical potential.

## 2. Data Job Posts Dataset

### Dataset Source:

- Kaggle-sourced dataset with 24 columns, 19,001 rows.
- Encompasses job title, company, location, and requirements.

### Description:

- Insights into job postings, eligibility, and application procedures.
- Valuable for trend analysis and understanding role requirements.

### Dataset Attributes:

- Job details, eligibility criteria, application procedures.
- Information on location, salary, duration, and audience.

### Dataset Size and Structure:

- 19,001 rows, 24 columns, 3.4+ MB memory usage.
- Rich in numerical and categorical data for market trend analysis.

## 3. Employee Dataset

### Dataset Source:

- Kaggle dataset with employee, job posts, and CV information.
- Employee: 3000 records, 26 attributes; Job Posts: 19001 records, 24 attributes; CV: 83439 records, 46 attributes.

### Description:

- Useful for people analytics, recruitment, and diverse data analyses.
- Comprehensive datasets catering to employee details, job posts, and CV attributes.

### Dataset Attributes:

- Employee data includes details like ID, name, job title, and performance score.
- Job posts feature info on titles, companies, locations, and salaries. CV data covers developer type, organization size, and compensation.

### Dataset Size and Structure:

- Employee: 3000 records, 26 attributes, 609.5+ KB memory.
- Job Posts: 19001 records, 24 attributes, 3.4+ MB memory. CV: 83439 records, 46 attributes, 29.3+ MB memory.

## 3.6 System Analysis

### 3.6.1 Actors

- Admin
- Job Seekers
- Businessmen
- HR

### 3.6.2 Function Requirements

#### ◎ Worker Login:

The worker will be able to enter their mail and password into the site to go their dashboard page.

#### ◎ HR Login:

The HR will be able to enter their mail and password into the site to go their dashboard page.

#### ◎ HR Signup:

HR will be able to enter some data like first name, last name, and university email to be able to access their own functionality through a dashboard.

#### ◎ Worker Signup:

Worker will be able to enter some data like first name, last name, and email to be able to access their own functionality through a dashboard.

#### ◎ HR validation:

The system checks and validate student's credentials and if correct they are logged in.

#### ◎ Worker validation.

The system checks and validate admin's credentials and if correct they are logged in.

#### ◎ Forgot password for HR:

HR will receive an email containing a link to reset their password on their account.

#### ◎ Forgot password for Worker:

Worker will receive an email containing a link to reset their password on their account.

#### ◎ Create CV:

- *User Input:* Name, address, contact information, objective, education details, work experience, skills, projects, awards, languages, etc.
- *Formatting Options:* Choose from various formatting options (font, layout, color schemes).
- *Auto-fill:* Provide the option to import information from LinkedIn or other sources.

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## ④ CV Template:

- *Template Options*: Offer a variety of professional templates catering to different industries.
- *Customization*: Allow users to customize the template according to personal preferences.
- *Preview*: Provide a preview of how the CV will look in different templates.

## ④ CV Review:

- *Automated Review*: Implement an AI-driven tool to check for grammar, spelling, and formatting errors.
- *Content Feedback*: Offer suggestions on content improvement, keyword optimization, and relevance.
- *Scan ability*: Evaluate how well the CV will be scanned by applicant tracking systems (ATS).

## ④ Create Online Meeting:

- *Scheduling*: Integrate with popular calendar apps for easy scheduling.
- *Meeting Link*: Generate a unique link for each meeting.
- *Reminders*: Send reminders to all participants before the meeting.

## ④ Find Job:

- *Job Search*: Integrate with popular job boards and company websites.
- *Filter jobs*: based on location, industry, experience level, etc.

## ④ Alerts:

- Allow users to set job alerts based on their preferences.

## ④ Application Tracking:

- Provide a dashboard to track job applications.

## ④ HR Topic Chatbot:

- *Knowledge Base*: Populate the chatbot with information on HR-related topics, company policies, and procedures.

## ④ Q&A:

- Answer common questions and provide relevant resources.

## ④ Feedback Collection:

- Gather feedback on HR processes and user satisfaction.

## ④ General Requirements:

- *User Authentication*: Secure user accounts with proper authentication mechanisms.
- *Mobile Compatibility*: Ensure that the platform is accessible and user-friendly on both desktop and mobile devices.
- *Data Privacy*: Adhere to data protection regulations and ensure user data is handled securely.
- *Feedback Mechanism*: Provide a way for users to give feedback on the platform's features.
- *Scalability*: Design the system to handle a growing number of users and data.

# CH.3 ANALYSIS & DESIGN



## ◎ Admin Functionality:

- *User Management:* Admin should be able to manage user accounts, roles, and permissions.
- *CV Review Oversight:* Admins should have access to CV review data and be able to oversee the automated review process.
- *Knowledge Base Management:* Admins can update and maintain the HR knowledge base for the chatbot.

### 3.6.3 Non-Function Requirements

#### ◎ Availability:

- The system should be available 99.9% of the time, allowing for scheduled maintenance.

#### ◎ Fault Tolerance:

- In the event of a system failure, the HRMS should have mechanisms in place to recover without data loss.

#### ◎ Security:

##### - *Data Encryption:*

All communication between users and the system should be encrypted. Employee data should be stored securely with access restricted to authorized personnel.

##### - *Authentication and Authorization:*

Implement strong user authentication mechanisms.

Define clear roles and permissions to ensure data access is restricted appropriately.

#### ◎ Scalability:

- *User Load:* The system should be designed to handle an increasing number of users and data without significant performance degradation.

#### ◎ Usability:

- *User Interface Responsiveness:* The user interface should be responsive and intuitive to ensure a positive user experience. Accessibility features should be incorporated to cater to users with disabilities.

#### ◎ Compatibility:

- *Browser Compatibility:* The HRMS should be compatible with major web browsers. Mobile responsiveness should be ensured for users accessing the system from various devices.

#### ◎ Maintainability:

- *Documentation:* Comprehensive documentation should be provided for

# CH.3 ANALYSIS & DESIGN



- system administrators, developers, and end-users.  
Code should be well-commented and follow coding standards.

## ◎ Integration:

- *Third-Party Integration:* The HRMS should seamlessly integrate with other enterprise systems, such as payroll and timekeeping.  
APIs should be well-documented for potential third-party integrations.

## ◎ Auditability:

- Audit Trail: The system should maintain an audit trail of user activities for security and compliance purposes.  
Logs should capture relevant information to trace any unauthorized access or modifications.

## ◎ Compliance:

- *Regulatory Compliance:* Ensure the HRMS complies with relevant data protection and privacy regulations.  
Stay up to date with legal requirements related to employee data management.

## ◎ Training and Support:

- *Training Materials:* Provide training materials and resources for both end-users and administrators.  
Offer responsive customer support to address user queries and issues promptly.

## 3.7 SYSTEM Models

### 3.7.1 Context Diagram

The AI-EHRMS, known as HRBotix, represents a groundbreaking solution that transcends traditional HR practices. In its intricate dance with external entities, HRBotix employs advanced technologies to elevate and streamline HR operations intelligently.

#### Interaction Flow:

- ▽ Clients enter the system, inputting search queries, and uploading detailed CVs to enhance their profiles.
- ▽ AI processes the uploaded CVs, extracting relevant information to understand clients' skills, experiences, and aspirations.
- ▽ Based on the AI analysis, personalized project recommendations are generated and compiled into AI-curated CVs.
- ▽ These curated CVs are sent to HR professionals, providing them with valuable insights for candidate evaluation during the hiring process.
- ▽ The centralized database ensures efficient storage and retrieval of data, contributing to informed decision-making and seamless interactions.

# CH.3 ANALYSIS & DESIGN

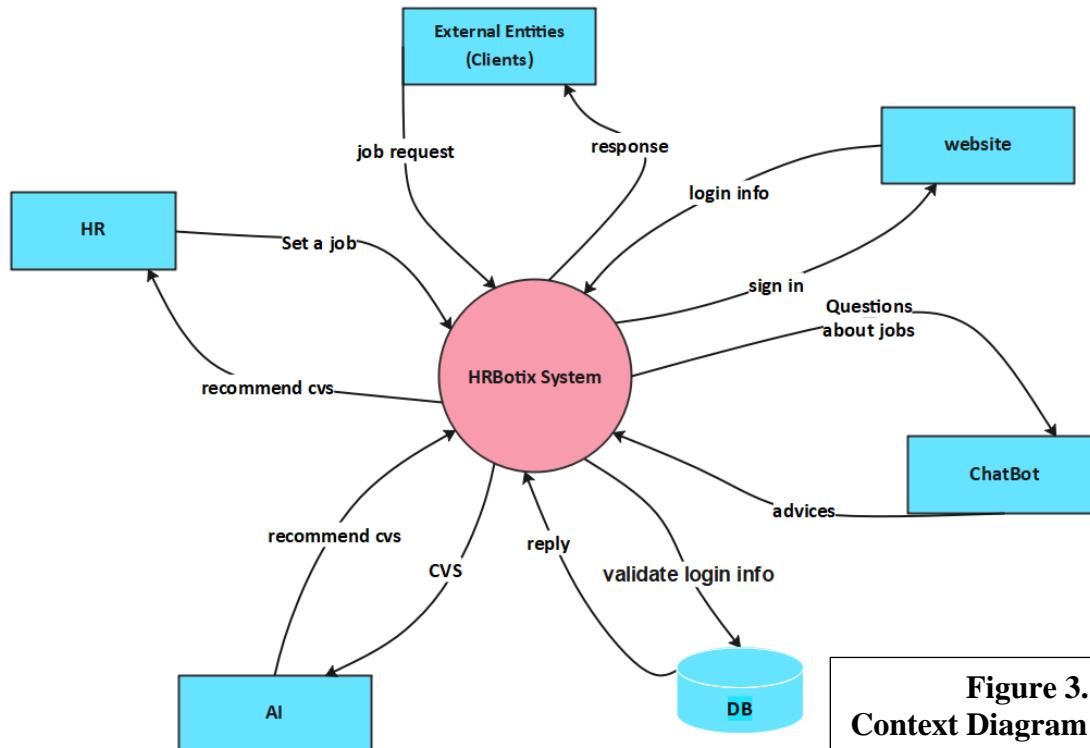


Figure 3.1  
Context Diagram

## Data Flow Diagram

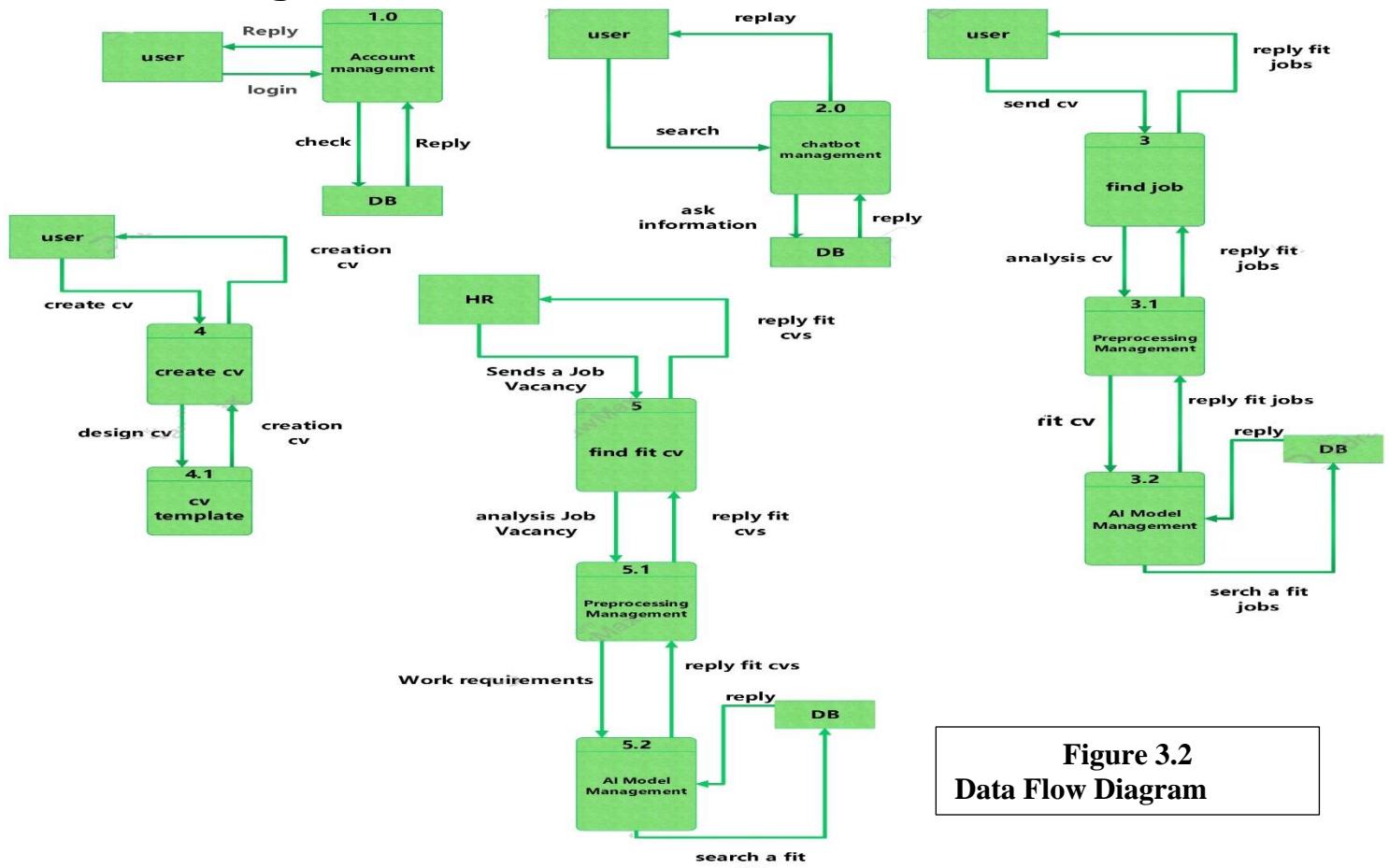


Figure 3.2  
Data Flow Diagram

# CH.3 ANALYSIS & DESIGN



## 3.7.2 Use case Diagram

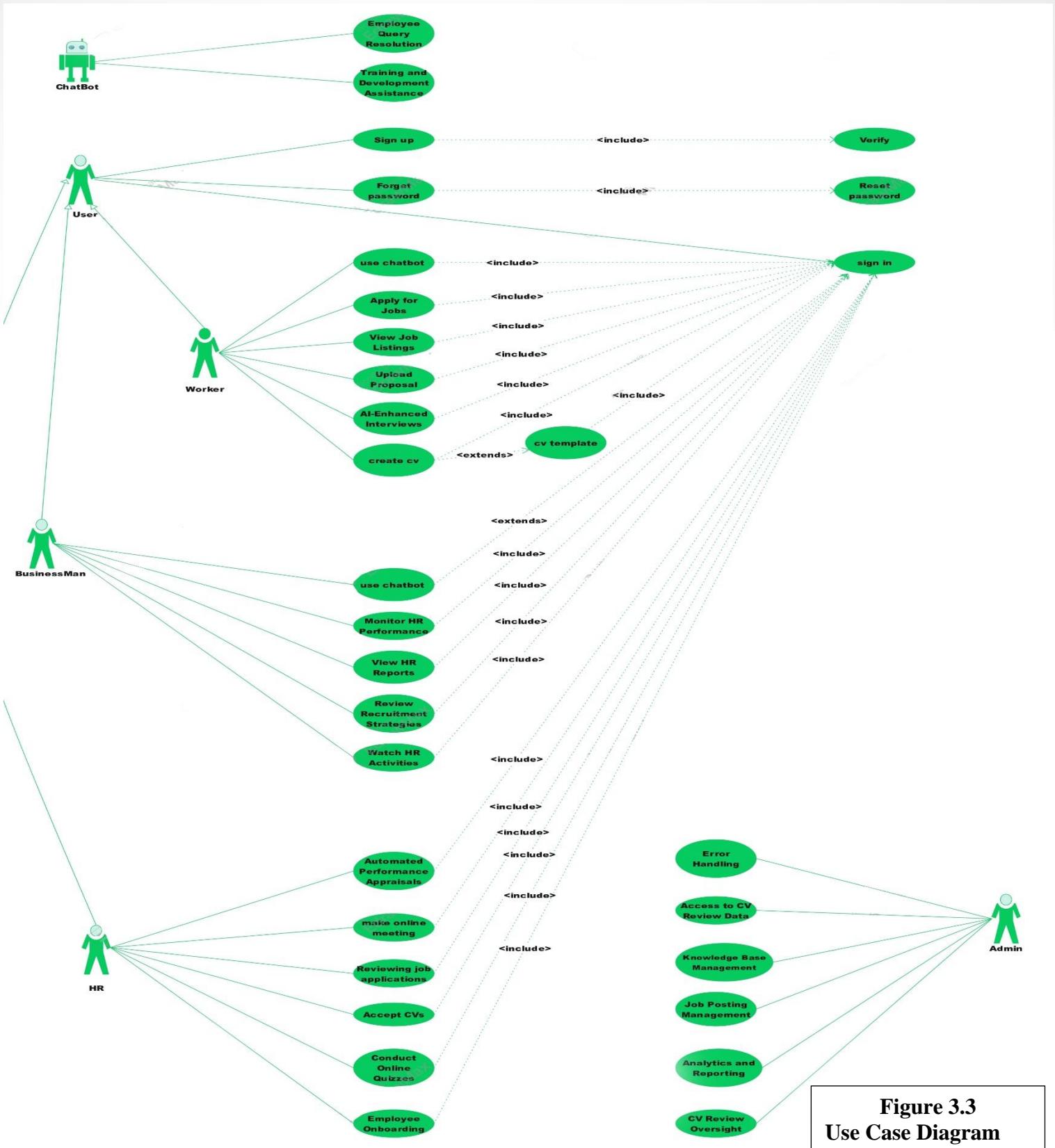


Figure 3.3  
Use Case Diagram

# CH.3 ANALYSIS & DESIGN



## 3.7.3 Class Diagram

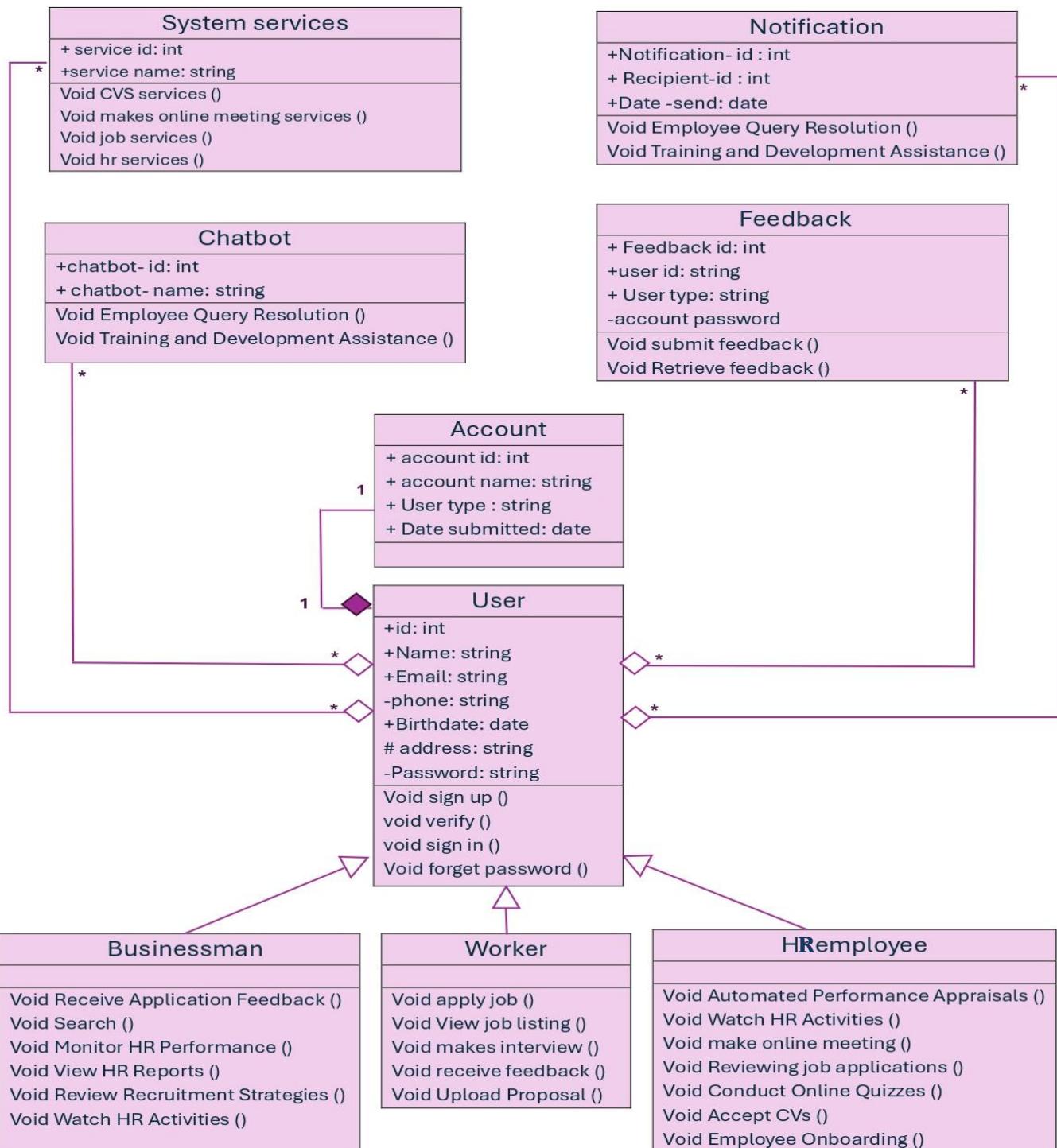


Figure 3.4  
Class Diagram

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## 3.7.4 ERD Diagram

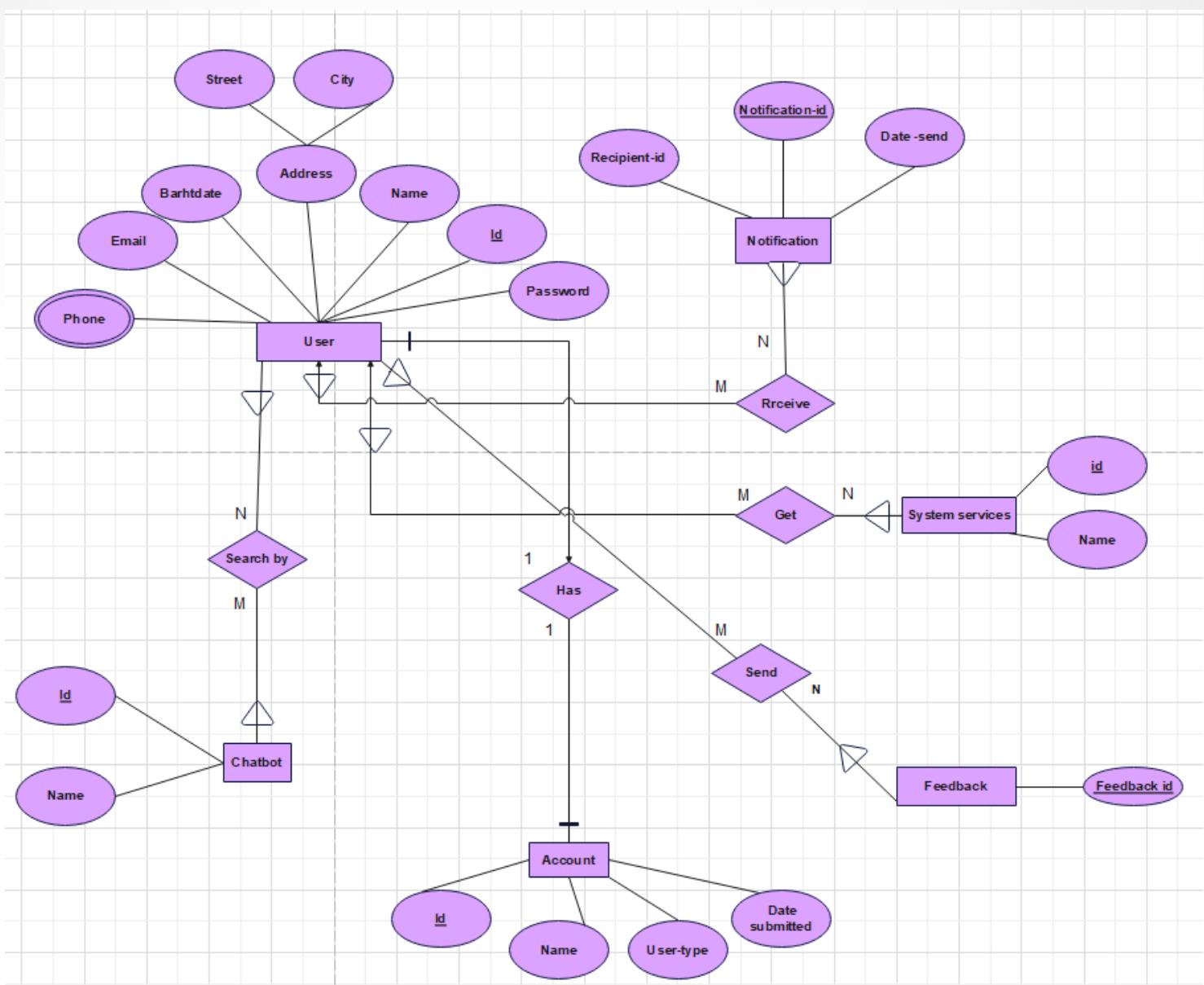


Figure 3.5  
ERD Diagram

# CH.3 ANALYSIS & DESIGN



## 3.7.5 Use Case Tables

Use Case Table 3.1: Resume Parsing and Candidate Screening

Use Case ID	1
Use Case Name	Resume Parsing and Candidate Screening
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Resumes of job applicants
Description	NLP processes resumes to extract relevant information, aiding in candidate screening.
Response	HR receives a shortlist of qualified candidates.
Comments & Exceptions	System prompts for manual review, error handling for misinterpretations.

Use Case Table 3.2: Applicant Tracking and Ranking

Use Case ID	2
Use Case Name	Applicant Tracking and Ranking
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Job requirements, candidate profiles
Description	ML algorithms rank candidates based on job requirements and past successful hires.
Response	Improved quality of candidates moved forward in the hiring process.
Comments & Exceptions	System employs fairness algorithms, error handling for biased results.

Use Case Table 3.3: Chatbots for Candidate and Employee Queries

Use Case ID	3
Use Case Name	Chatbots for Candidate and Employee Queries
Actors	HR, Job Applicants, Employees
Precondition	HR, job applicants, or employees interacting with the system.
Input Data	User queries
Description	Conversational AI interacts with users to answer HR-related questions in real-time.
Response	Users receive instant support and information.
Comments & Exceptions	System prompts for clarification, error handling for misunderstood queries.

# CH.3 ANALYSIS & DESIGN



Use Case Table 3.4: Employee Sentiment Analysis

Use Case ID	4
Use Case Name	Employee Sentiment Analysis
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Employee feedback, survey responses
Description	NLP analyzes employee sentiment from various sources.
Response	Insights into employee morale and potential issues.
Comments & Exceptions	System prompts for manual review, error handling for sentiment misjudgments.

Use Case Table 3.5: Training and Development Programs

Use Case ID	5
Use Case Name	Training and Development Programs
Actors	HR, Employees
Precondition	HR is logged into the AI-EHRMS.
Input Data	Employee roles, skills gaps, career goals
Description	AI recommends personalized learning programs based on employee needs.
Response	Facilitates continuous professional development.
Comments & Exceptions	System prompts for user feedback, error handling for inaccurate recommendations.

Use Case Table 3.6: Performance Management

Use Case ID	6
Use Case Name	Performance Management
Actors	HR, Employees
Precondition	HR is logged into the AI-EHRMS.
Input Data	Employee performance data
Description	AI tracks and analyzes employee performance, providing insights for reviews.
Response	Supports objective performance evaluations and goal setting.
Comments & Exceptions	System prompts for data completion, error handling for inconsistencies.

# CH.3 ANALYSIS & DESIGN



Use Case Table 3.7: Workforce Analytics and Planning

Use Case ID	7
Use Case Name	Workforce Analytics and Planning
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Workforce data, staffing needs
Description	AI analyzes workforce data for strategic decision-making on hiring, layoffs, and restructuring.
Response	Informed decisions on staffing and departmental changes.
Comments & Exceptions	System prompts for data validation, error handling for discrepancies.

Use Case Table 3.8: Compliance Monitoring

Use Case ID	8
Use Case Name	Compliance Monitoring
Actors	HR, Legal Team
Precondition	HR is logged into the AI-EHRMS.
Input Data	Labor laws and regulations
Description	AI algorithms monitor and ensure compliance with labor laws and regulations.
Response	Minimizes the risk of legal issues and maintains ethical standards.
Comments & Exceptions	System prompts for corrective actions, error handling for compliance discrepancies.

Use Case Table 3.9: Diversity and Inclusion Analytics

Use Case ID	9
Use Case Name	Diversity and Inclusion Analytics
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Employee demographic data
Description	AI analyzes demographic data to provide insights into diversity and inclusion within the organization.
Response	HR receives analytics on diversity metrics, helping in strategic planning.
Comments & Exceptions	Robust data validation to avoid errors in the analysis process.

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Use Case Table 3.10: Onboarding Assistance

Use Case ID	10
Use Case Name	Onboarding Assistance
Actors	HR, New Employees
Precondition	HR is logged into the AI-EHRMS, New employees are onboarded.
Input Data	New employee details, onboarding checklist
Description	AI assists HR in onboarding processes by providing guidance to new employees, answering queries, and ensuring completion of onboarding tasks.
Response	Smooth onboarding experience for new employees.
Comments & Exceptions	System prompts for completion of pending tasks, error handling for system issues.

Use Case Table 3.11: Succession Planning

Use Case ID	11
Use Case Name	Succession Planning
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Employee performance history, potential successors
Description	AI assists in identifying and evaluating potential successors for key roles within the organization.
Response	Succession plans are generated, ensuring a smooth transition in case of key personnel changes.
Comments & Exceptions	System prompts for reconsideration, error handling for evaluation issues.

Use Case Table 3.12: Talent Pipelining

Use Case ID	12
Use Case Name	Talent Pipelining
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Talent requirements, external candidate profiles
Description	AI helps HR in building a talent pipeline by identifying and engaging with potential candidates for future roles.
Response	Proactive talent acquisition and reduced time-to-fill for critical positions.
Comments & Exceptions	System prompts for re-engagement, error handling for candidate disinterest.

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Use Case Table 3.13: Employee Wellness Monitoring

Use Case ID	13
Use Case Name	Employee Wellness Monitoring
Actors	HR
Precondition	HR is logged into the AI-EHRMS.
Input Data	Employee wellness data, health-related surveys
Description	AI monitors and analyzes employee wellness data, providing insights into overall well-being.
Response	HR receives reports on employee wellness trends, facilitating wellness program planning.
Comments & Exceptions	System prompts for complete data, error handling for inconsistent entries.

Use Case Table 3.14: Adaptive Learning Paths

Use Case ID	14
Use Case Name	Adaptive Learning Paths
Actors	HR, Learning and Development Team
Precondition	HR is logged into the AI-EHRMS.
Input Data	Employee learning history, skill assessments
Description	AI recommends adaptive learning paths for employees, dynamically adjusting based on performance and skill development.
Response	Employees receive personalized learning journeys, optimizing skill development.
Comments & Exceptions	System adjusts paths based on real-time performance, error handling for unexpected changes.

Use Case Table 3.15: Job Search and Application for Job Seekers

Use Case ID	15
Use Case Name	Job Search and Application
Actors	Job Seeker
Precondition	Job Seeker is logged into the AI-EHRMS.
Input Data	Job preferences, qualifications, and desired job criteria.
Description	Job Seeker searches for relevant job opportunities using the AI-EHRMS platform and submits applications for desired positions.
Response	Job Seeker receives a list of matching job opportunities and confirms successful application submissions.
Comments & Exceptions	System prompts for verification, error handling for submission failures.

# CH.3 ANALYSIS & DESIGN



Use Case Table 3.16: Skill Enhancement Recommendations for Job Seekers

Use Case ID	16
Use Case Name	Skill Enhancement Recommendations
Actors	Job Seeker
Precondition	Job Seeker is logged into the AI-EHRMS.
Input Data	Job Seeker's current skills, career goals, and industry trends.
Description	AI analyzes Job Seeker's skills, career goals, and industry trends to recommend skill enhancement opportunities for better job prospects.
Response	Job Seeker receives personalized recommendations for skill development programs.
Comments & Exceptions	System prompts for verification, error handling for recommendation mismatches.

Use Case Table 3.17: Project Recommendation for Businessmen

Use Case ID	17
Use Case Name	Project Recommendation for Businessmen
Actors	Businessman
Precondition	Businessman is logged into the AI-EHRMS.
Input Data	Businessman's industry preferences, investment criteria, and business goals.
Description	AI analyzes Businessman's preferences and goals to recommend suitable projects for investment or collaboration.
Response	Businessman receives a list of recommended projects aligning with their business interests.
Comments & Exceptions	System prompts for verification, error handling for recommendation discrepancies.

Use Case Table 3.18: Market Trends Analysis for Businessmen

Use Case ID	18
Use Case Name	Market Trends Analysis for Businessmen
Actors	Businessman
Precondition	Businessman is logged into the AI-EHRMS.
Input Data	Businessman's industry, market trends, and competitive landscape.
Description	AI provides real-time analysis of market trends, industry insights, and competitive intelligence for Businessmen to make informed business decisions.
Response	Businessman gains insights into market dynamics, enabling strategic planning.
Comments & Exceptions	System prompts for verification, error handling for analysis inconsistencies.

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Use Case Table 3.19: Networking Opportunities for Businessmen

Use Case ID	19
Use Case Name	Networking Opportunities for Businessmen
Actors	Businessman
Precondition	Businessman is logged into the AI-EHRMS.
Input Data	Businessman's professional interests, industry events, and networking preferences.
Description	AI identifies relevant networking events, conferences, and industry gatherings based on Businessman's profile and preferences.
Response	Businessman receives curated recommendations for networking opportunities to expand professional connections.
Comments & Exceptions	System prompts for verification, error handling for recommendation discrepancies.

Use Case Table 3.20: User Management

Use Case ID	20
Use Case Name	User Management
Actors	Admin
Precondition	None
Input Data	User accounts, roles, and permissions
Description	Admin can manage user accounts, assign roles, and update permissions without explicit login
Response	Changes to user accounts, roles, and permissions are updated in the system
Comments & Exceptions	System prompts for verification, error handling for role conflicts

Use Case Table 3.21: CV Review Oversight

Use Case ID	21
Use Case Name	CV Review Oversight
Actors	Admin
Precondition	None
Input Data	CV review data from the automated review process
Description	Admin can access CV review data and oversee the automated review process without explicit login
Response	Admin gains insights into CV review outcomes and ensures the quality of the automated process
Comments & Exceptions	System prompts for manual review, error handling for irregularities

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Use Case Table 3.22: Knowledge Base Management

Use Case ID	22
Use Case Name	Knowledge Base Management
Actors	Admin
Precondition	None
Input Data	Updates and additions to HR knowledge base content for the chatbot
Description	Admin can update and maintain the HR knowledge base without explicit login, ensuring it is accurate and up-to-date for the chatbot
Response	Knowledge base content is updated and available for the chatbot to provide accurate information
Comments & Exceptions	System prompts for verification, error handling for knowledge base inconsistencies

# CH.3 ANALYSIS & DESIGN



## 3.8 Sequence Diagram

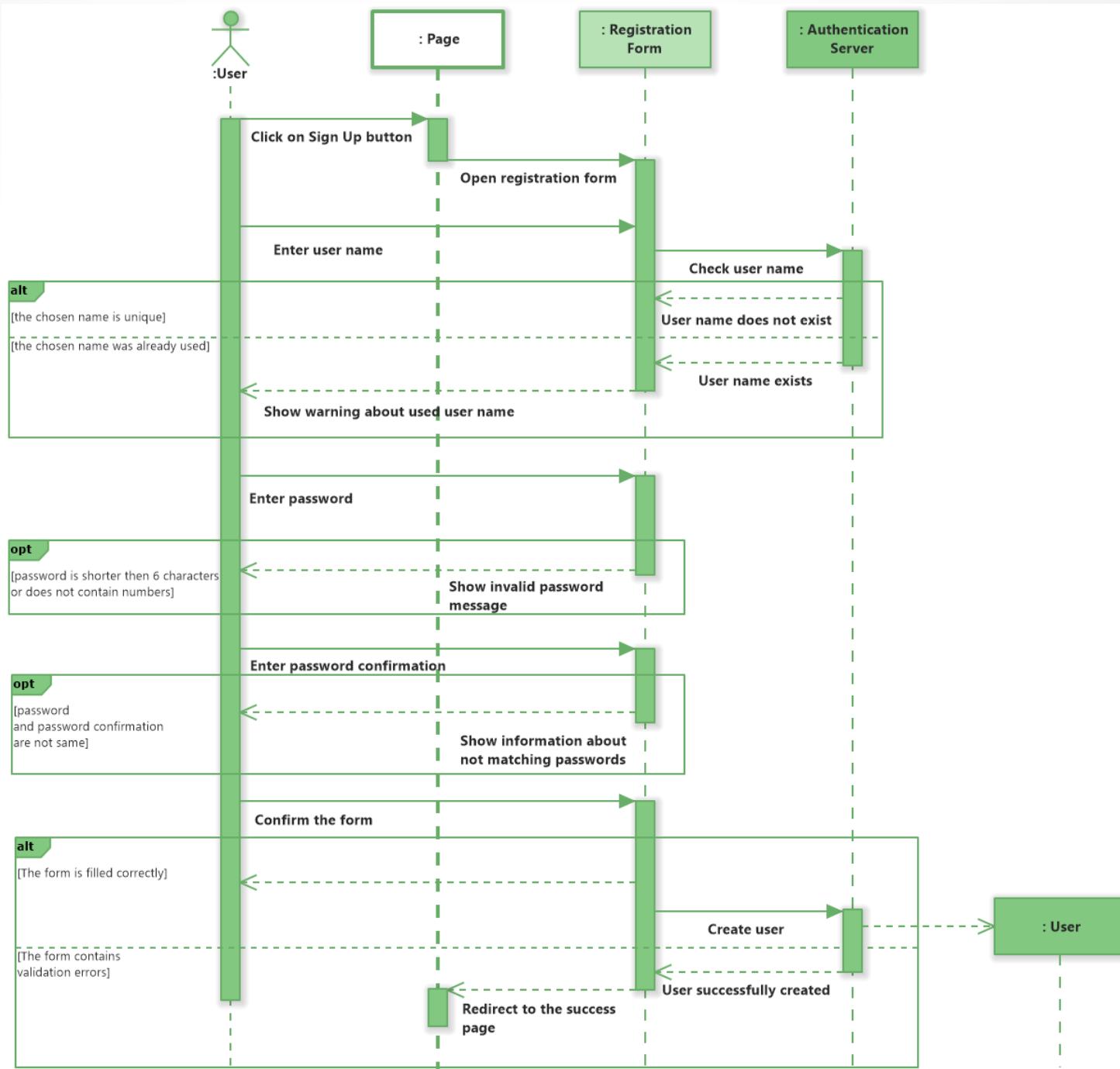


Figure 3.6  
Sequence Diagram for Sign up page.

# CH.3 ANALYSIS & DESIGN



Sequence Diagram for Login Page

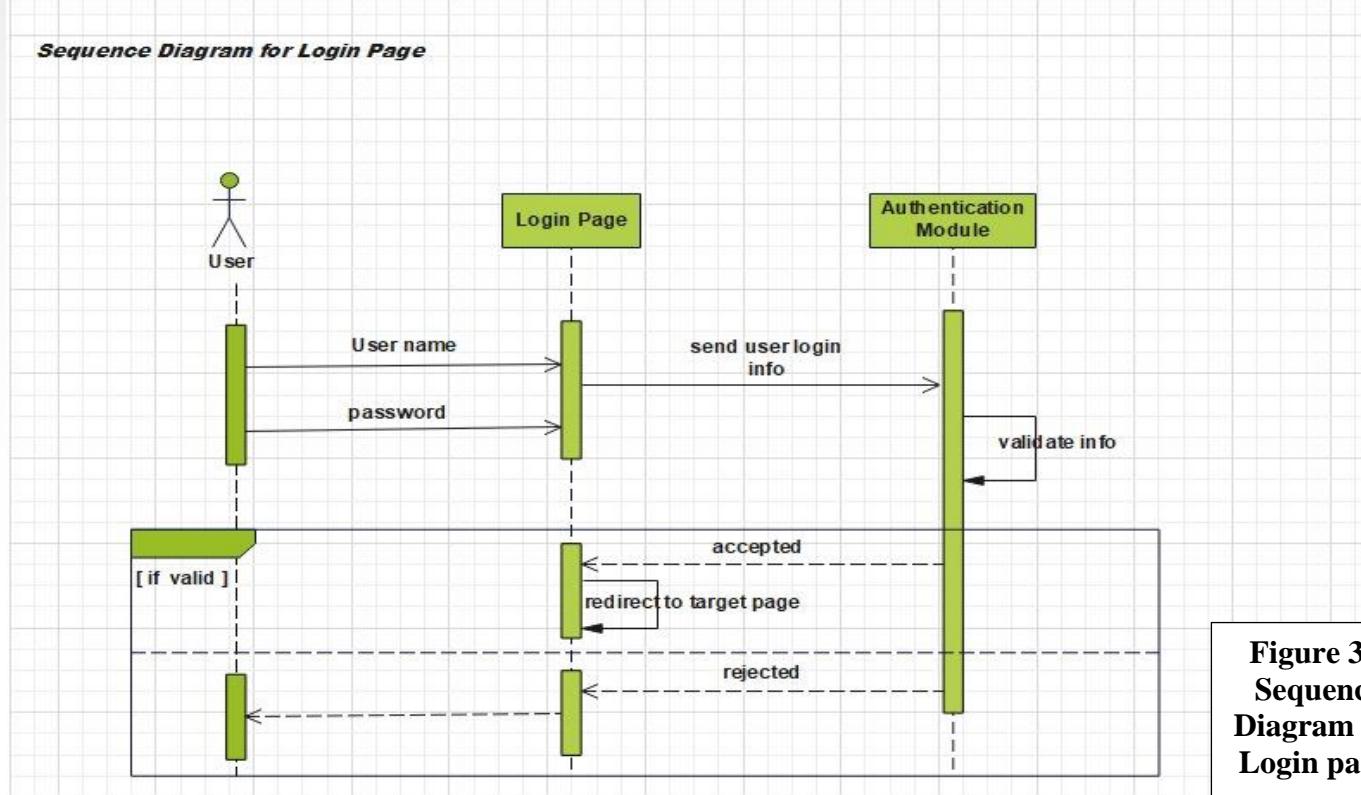


Figure 3.7  
Sequence  
Diagram for  
Login page.

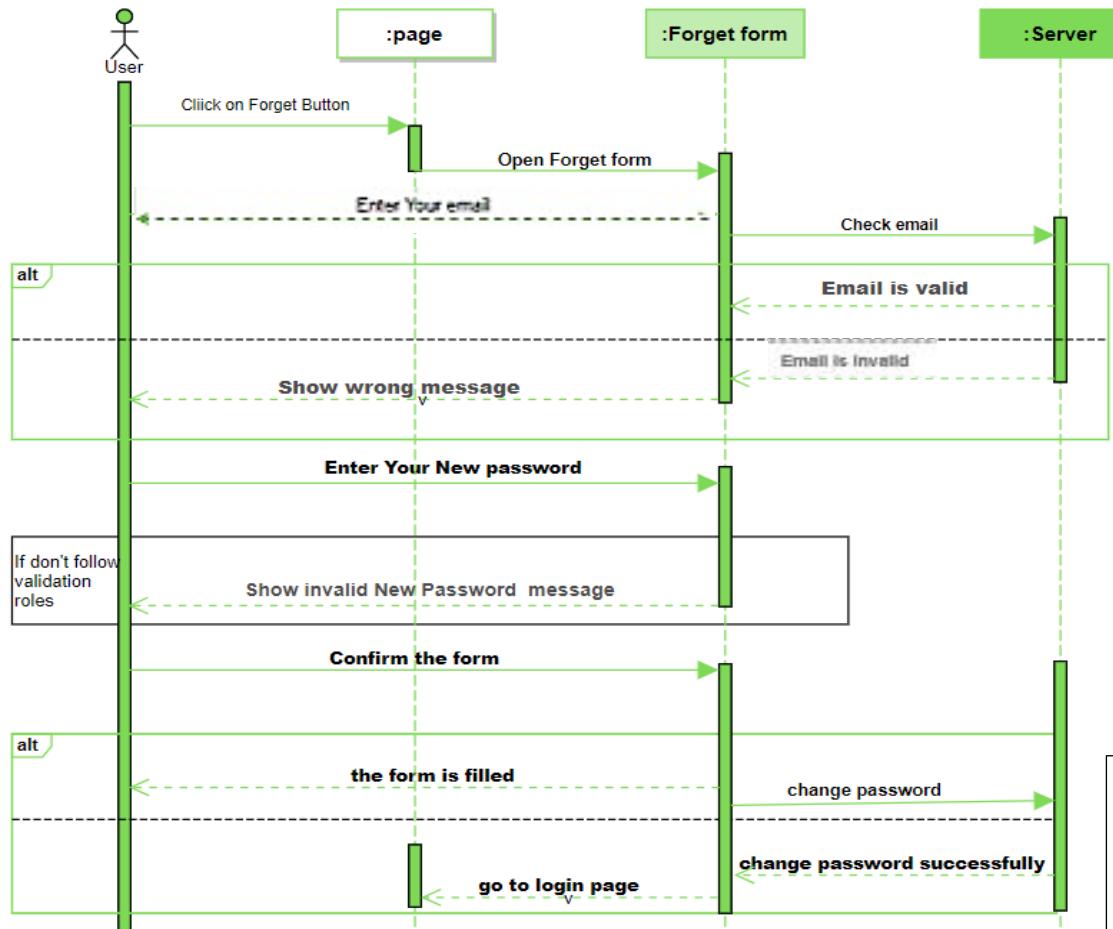


Figure 3.8  
Sequence  
Diagram for  
Forget form.

# CH.3 ANALYSIS & DESIGN

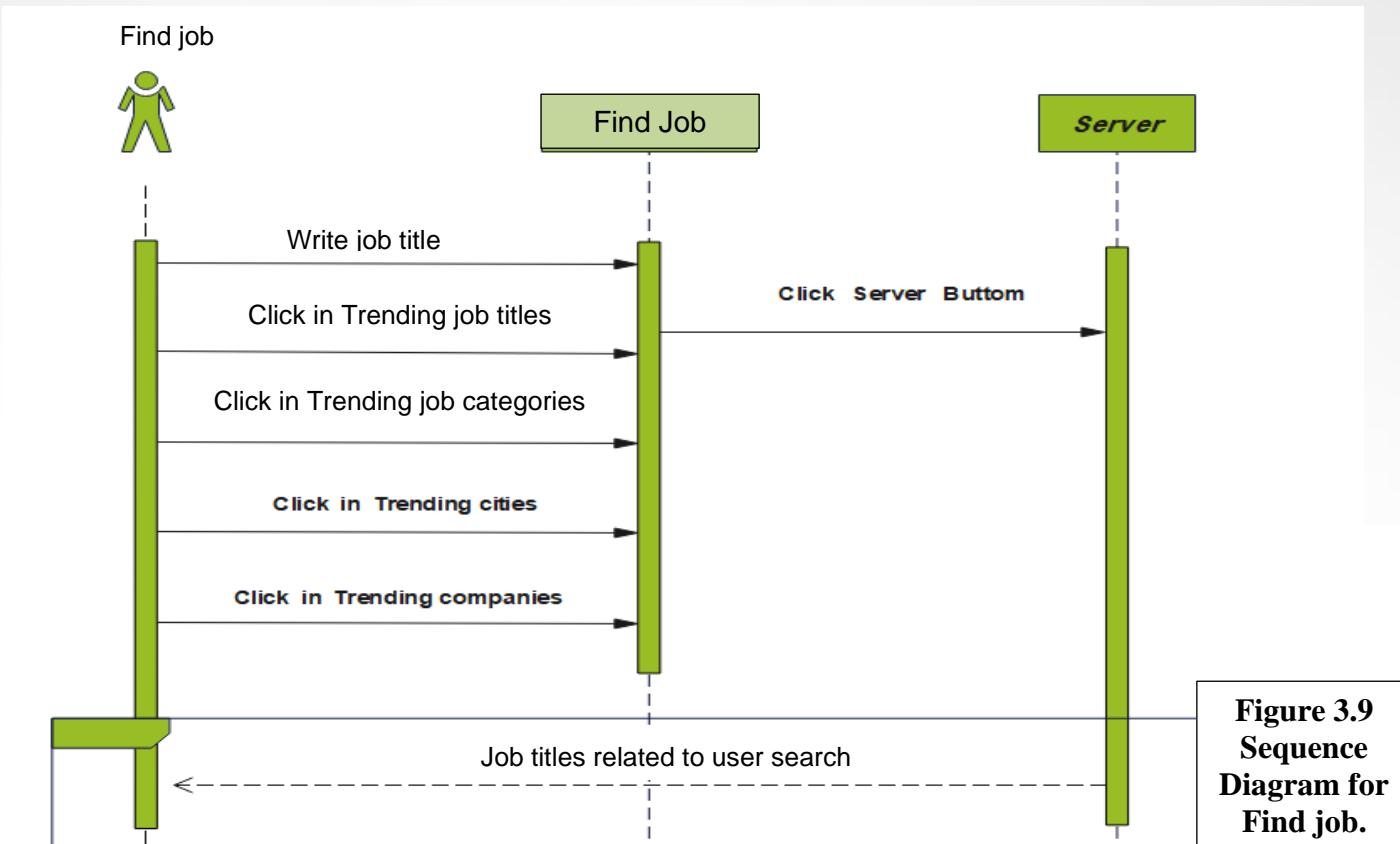


Figure 3.9  
Sequence  
Diagram for  
Find job.

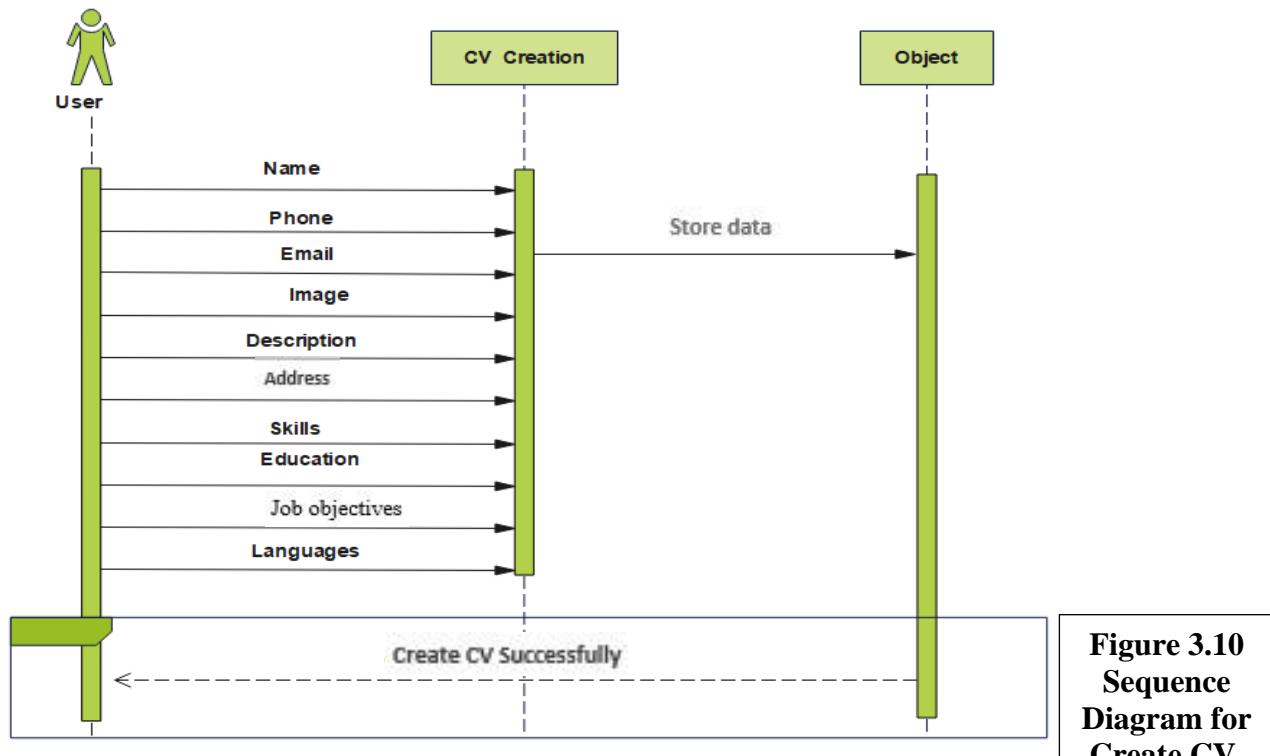


Figure 3.10  
Sequence  
Diagram for  
Create CV.

# CH.3 ANALYSIS & DESIGN



CV Review

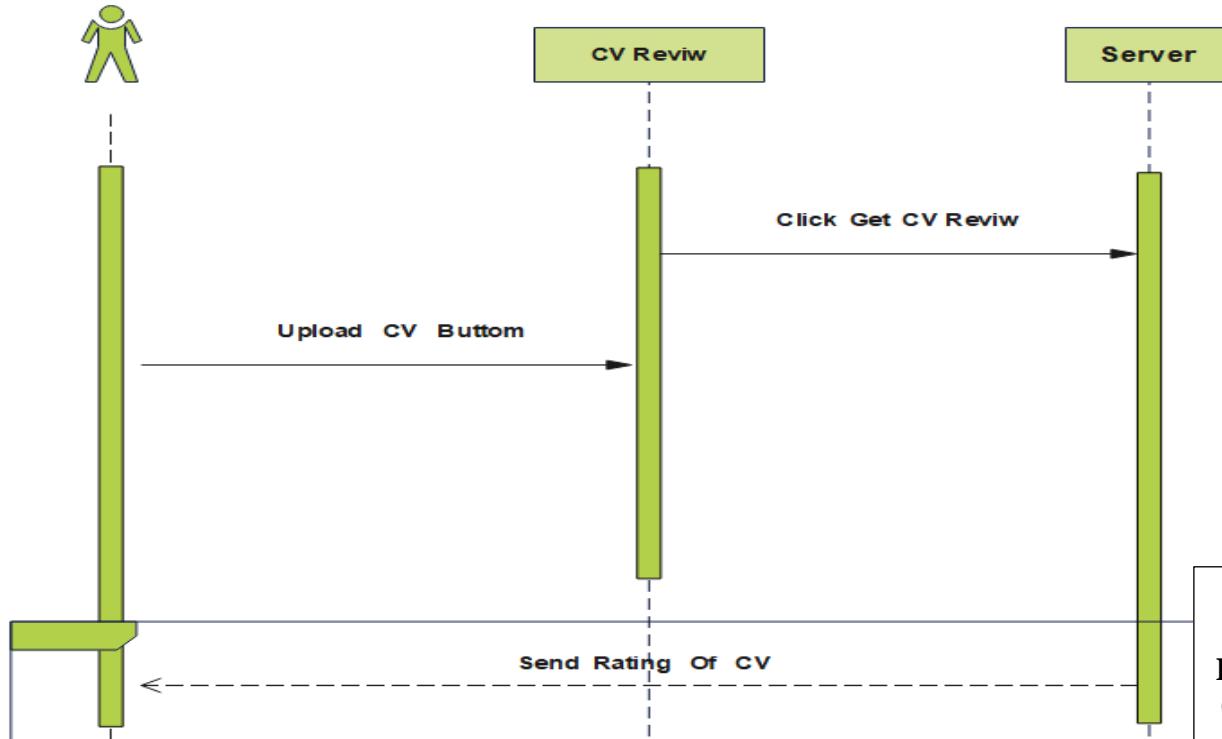


Figure 3.11  
Sequence Diagram for CV Review.

Online Meeting

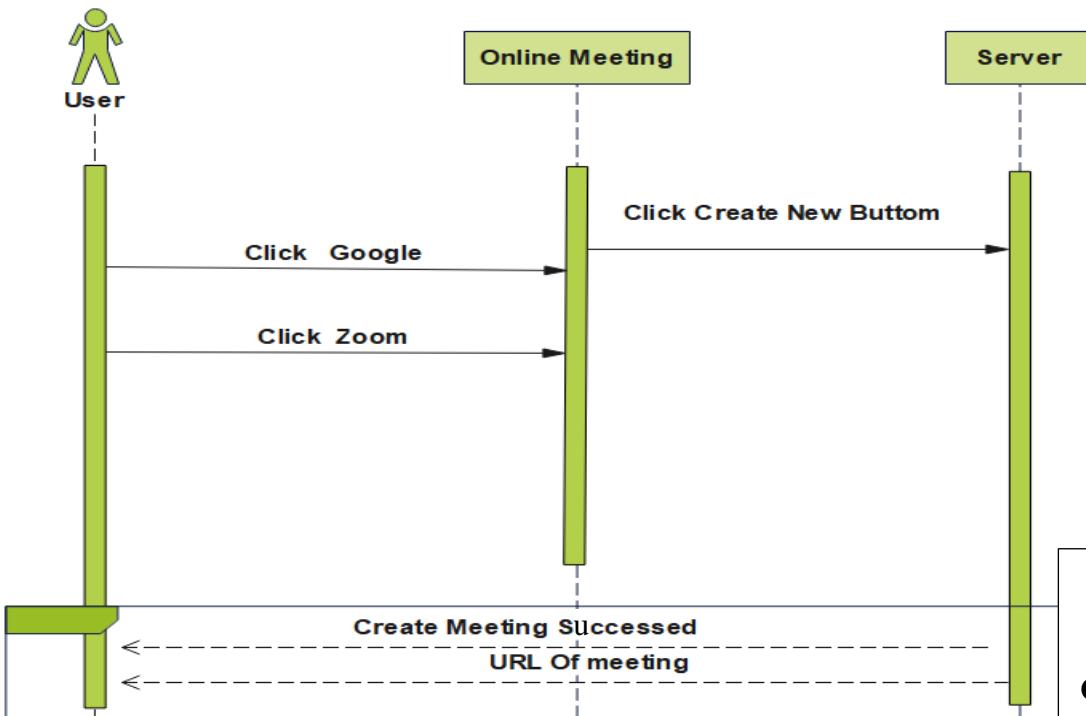


Figure 3.12  
Sequence Diagram for Online Meeting.

# CH.3 ANALYSIS & DESIGN



## 3.9 Functional Analysis

Table 3.23

Function Name	HR Botix System	Job Leads Website	Bayt.com Website	Glassdoor: Jobs & Community App
Job Search	✓	✓	✓	✓
AI-Powered hiring	✓	✓	✓	✓
Resume Review	✓	✓	✓	✓
CV Template	✓	✗	✗	✗
Create Online Meeting	✓	✗	✗	✗
Chatbot	✓	✗	✗	✓
HR Topic	✓	✗	✗	✓
Providing Salary Information	✗	✗	✗	✓
Tracking Job Application	✓	✗	✗	✓

# CH.3 ANALYSIS & DESIGN



## 3.10 Data Privilege

**Table 3.24 Client Data Privileges:**

Order	Data Privilege	Description
1.	Login	Log in to the AI-EHRMS System.
2.	Signup	Create a new account in the AI-EHRMS System.
3.	Forgot Password	Recover the AI-EHRMS account password.
4.	Reset Password	Reset the AI-EHRMS account password.
5.	Search jobs	Use the AI to find projects and jobs.
6.	Upload Proposal	Upload project proposals or job descriptions.
7.	View projects recommended by the AI system.	View projects recommended by the AI system.
8.	Apply to projects or job opportunities.	Apply to projects or job opportunities.
9.	Track the status of project or job applications.	Track the status of project or job applications.
10.	Receive AI-enhanced feedback on applications.	Receive AI-enhanced feedback on applications.
11.	Participate in AI-enhanced interview processes.	Participate in AI-enhanced interview processes.
12.	Add projects or jobs to favorites list.	Add projects or jobs to favorites list.

# CH.3 ANALYSIS & DESIGN



**Table 3.25 HR Data Privileges:**

Order	Data Privilege	Description
1.	Login	Log in to the AI-EHRMS System.
2.	Signup	Create a new account in the AI-EHRMS System.
3.	Forgot Password	Recover the AI-EHRMS account password.
4.	Reset Password	Reset the AI-EHRMS account password.
5.	Track Application Status	Track the status of project or job applications.
6.	Receive AI Feedback	Receive AI-enhanced feedback on applications.
7.	AI-Enhanced Interviews	Participate in AI-enhanced interview processes.
8.	Add Project to Favorites	Add projects or jobs to favorites list.
9.	Make Meetings	Schedule and conduct meetings.
10.	Conduct Online Quizzes	Administer online quizzes for applicants.
11.	Accept CVs	Receive and review CVs submitted by clients.

**Table 3.26 Businessmen Privileges:**

Order	Data Privilege	Description
1.	Login	Log in to the AI-EHRMS System.
2.	Signup	Create a new account in the AI-EHRMS System.
3.	Forgot Password	Recover the AI-EHRMS account password.
4.	Reset Password	Reset the AI-EHRMS account password.
5.	Search	Permits businessmen to use the chatbot without logging in.
6.	View HR Reports	Provides access to view HR reports.
7.	Watch HR Activities	Allows observation and tracking of HR activities.
8.	View Business Analytics	Grants access to business analytics for trend analysis.
9.	Participate in HR Feedback	Enables providing feedback on HR processes.
10.	Receive AI Recommendations	Allows receiving AI-generated recommendations.

# CH.3 ANALYSIS & DESIGN



**Table 3.27 Admin Data Privileges:**

Order	Data Privilege	Description
1.	User Management	Manage user accounts, roles, and permissions.
2.	CV Review Oversight	Access CV review data and oversee automated review processes.
3.	Knowledge Base Management	Update and maintain the HR knowledge base for the chatbot.
4.	Update User Information	Modify user details, such as name and contact info.
5.	Assign Roles	Assign specific roles to users for access control.
6.	Manage Permissions	Control and update user permissions in the system.
7.	Review CV Data	Access and review CV data for hiring decisions.
8.	Access Reports	Retrieve and view various reports related to HR activities.
9.	Schedule and Conduct Meetings	Ability to schedule and conduct HR-related meetings.
10.	Administer Online Quizzes	Conduct online quizzes for HR-related assessments.
11.	Monitor Business Analytics	View analytics related to business trends and performance.

# CH.3 ANALYSIS & DESIGN



## 3.11 Database Design

### 1) Table 3.28 Sign Up DATABASE DESIGN

Field Name	Data Type	Width	Value
ID	Number	8	Not Null, Primary Key
First Name	Character	20	Not Null
Last Name	Character	20	Not Null
Date of Birth	Date	15	Not Null
Email	Character	50	Not Null, Unique
Password	Character	20	Not Null
User Type	Character	20	Not Null (Values: 'Job Applicant', 'HR Employee', 'Businessman')
Resume	Text	-	Nullable (Job Applicants only)
Skills	Character	100	Nullable (Job Applicants only)
Education	Character	50	Nullable (Job Applicants only)
Department	Character	30	Nullable (HR Employees only)
Position	Character	30	Nullable (HR Employees only)
Company Name	Character	50	Nullable (Businessmen only)
Industry	Character	30	Nullable (Businessmen only)

# CH.3 ANALYSIS & DESIGN



## 2) Table 3.29 Feedback DATABASE DESIGN

Field Name	Data Type	Width	Value
<b>ID</b>	Number	8	Not Null, primary key
<b>User ID</b>	Number	8	Not Null
<b>Question ID</b>	Number	8	Not Null
<b>Answer</b>	Text	-	Nullable

## 3) Table 3.30 CVs DATABASE DESIGN

Field Name	Data Type	Width	Value
<b>ID</b>	Number	8	Not Null, primary key
<b>First Name</b>	Character	20	Not Null
<b>Last Name</b>	Character	20	Not Null
<b>Date of Birth</b>	Date	15	Not Null
<b>Email</b>	Character	20	Not Null
<b>Password</b>	Character	20	Not Null
<b>Phone Number</b>	Character	20	Not Null
<b>Address</b>	Character	50	Not Null
<b>City</b>	Character	20	Not Null
<b>State</b>	Character	20	Not Null
<b>Zip Code</b>	Character	10	Not Null
<b>Education</b>	Character	50	Not Null
<b>Experience</b>	Character	50	Not Null
<b>Skills</b>	Character	50	Not Null

# CH.3 ANALYSIS & DESIGN



## 4) Table 3.31 Employee DATABASE DESIGN

Field Name	Data Type	Width	Value
<b>ID</b>	Number	8	Not Null, primary key
<b>First Name</b>	Character	20	Not Null
<b>Last Name</b>	Character	20	Not Null
<b>Date of Birth</b>	Date	15	Not Null
<b>Email</b>	Character	20	Not Null
<b>Password</b>	Character	20	Not Null
<b>Phone Number</b>	Character	20	Not Null
<b>Address</b>	Character	50	Not Null
<b>City</b>	Character	20	Not Null
<b>State</b>	Character	20	Not Null
<b>Zip Code</b>	Character	10	Not Null
<b>Job Title</b>	Character	20	Not Null
<b>Department</b>	Character	20	Not Null
<b>Salary</b>	Number	10	Not Null

# CH.3 ANALYSIS & DESIGN



## 3.12 Summary

The "Analysis & Design" chapter of the AI-Enhanced Human Resource Management System research project is a comprehensive exploration of the system development process. It starts with an in-depth analysis, identifying system functions and establishing a robust foundation for design. The chapter addresses data gathering, introducing dataset sources and effective utilization. Noteworthy models, including context diagrams and data flow diagrams, are presented for a holistic understanding of the system's structure.

The chapter further covers system actors, functional and non-functional requirements, and provides detailed system models such as use case diagrams, class diagrams, ERDs, and use case tables. Additionally, it delves into sequence diagrams, functional analysis, data privilege management for roles like admin and student, and concludes with a focus on database design. The chapter ensures a thorough exploration of challenges, opportunities, and a proposed solution in the context of AI-enhanced HR management.



## 4.1 Introduction

In this chapter we will discuss the design phase and how it will look like in the proposed system and its attributes and actions and capabilities. During the Design Phase, the system is designed to satisfy the requirements identified in the previous phases.

The requirements identified in the Requirements Analysis Phase then transformed into a System Design Document that accurately describes the design of the system and that can be used as an input to system development in the next phase.

## 4.2 System Architecture

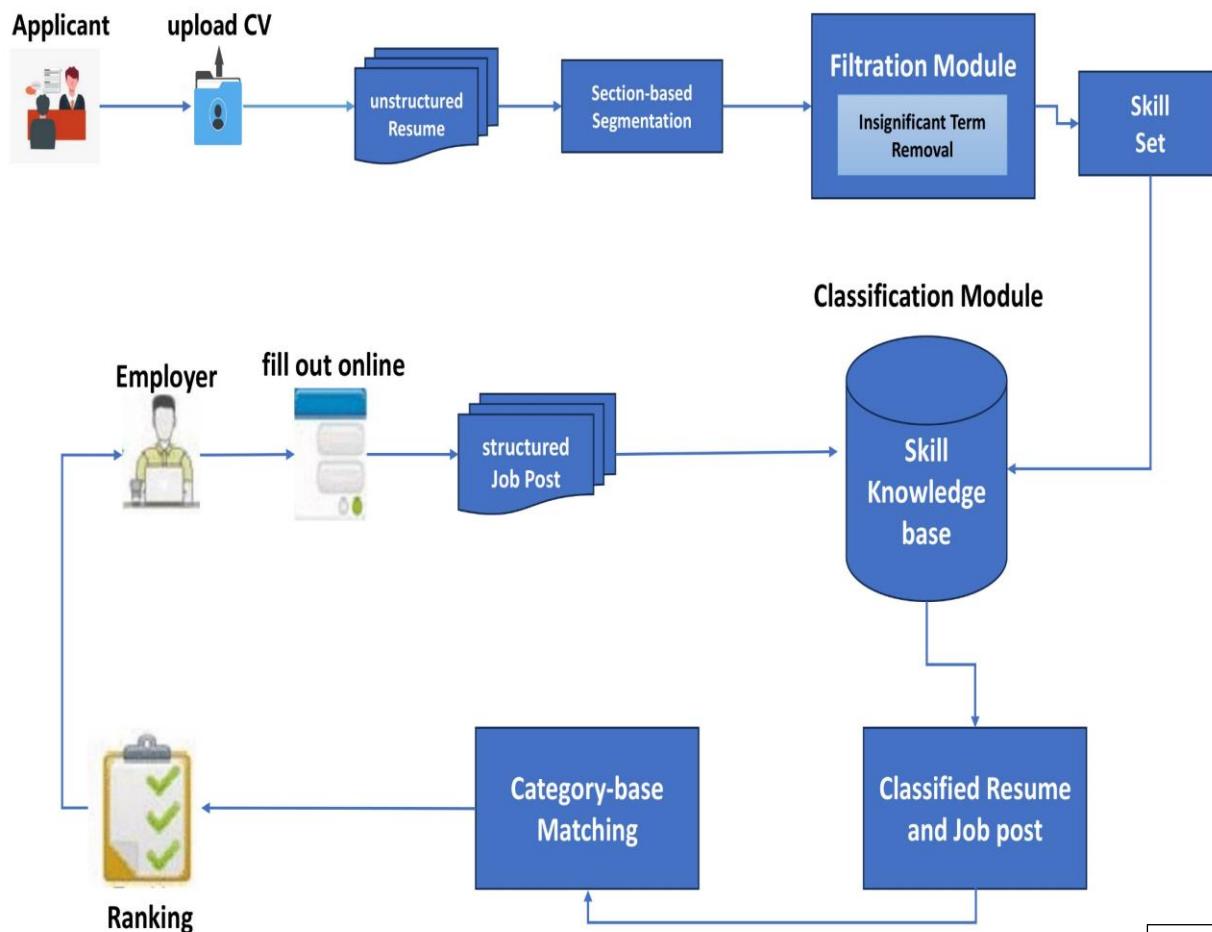


Figure 4.1  
System  
Architecture.

## 4.3 User Interface Design

User Interface Design focuses on anticipating what users might need to do and ensuring that the interface has elements that are easy to access, understand, and use to facilitate those actions. When designing a user interface, there are many design considerations and principles that are considered to ensure that the interface meets the needs of users and are effective in achieving its intended purpose. Here are some key considerations and principles:

- **Usability:** User interface design focuses on the needs and preferences of users. This means that the design is intuitive and easy to use.
- **Accessibility:** This includes the use of appropriate color contrast, and the ability to navigate the interface using keyboard controls.
- **Responsiveness:** Responsive user interface design for various screen sizes and devices, including desktops, laptops, tablets, and smartphones. The interface is designed with a flexible layout that adapts to different screen sizes.

### 4.3.1 Main Page Screen

This is the main page through which we can navigate to all the pages and services available on the site, etc.

The main page serves as a centralized hub, featuring three core elements: CV Services, Online Meetings, and HR functionalities, complemented by a log-out option. CV Services encompass crafting personalized resumes, accessing pre-designed templates, and ensuring CV accuracy through reviews. Online Meetings offer remote capabilities for job suitability assessments. Job Search facilitates the exploration of employment opportunities and company research.

The platform also provides comprehensive information on job functions and HR content, enhancing industry understanding. The strategically placed log-out button ensures secure profile exits, contributing to a meticulously designed main page that seamlessly integrates CV management, job-seeking, and professional networking within an intuitive interface.

# CH.4 System DESIGN

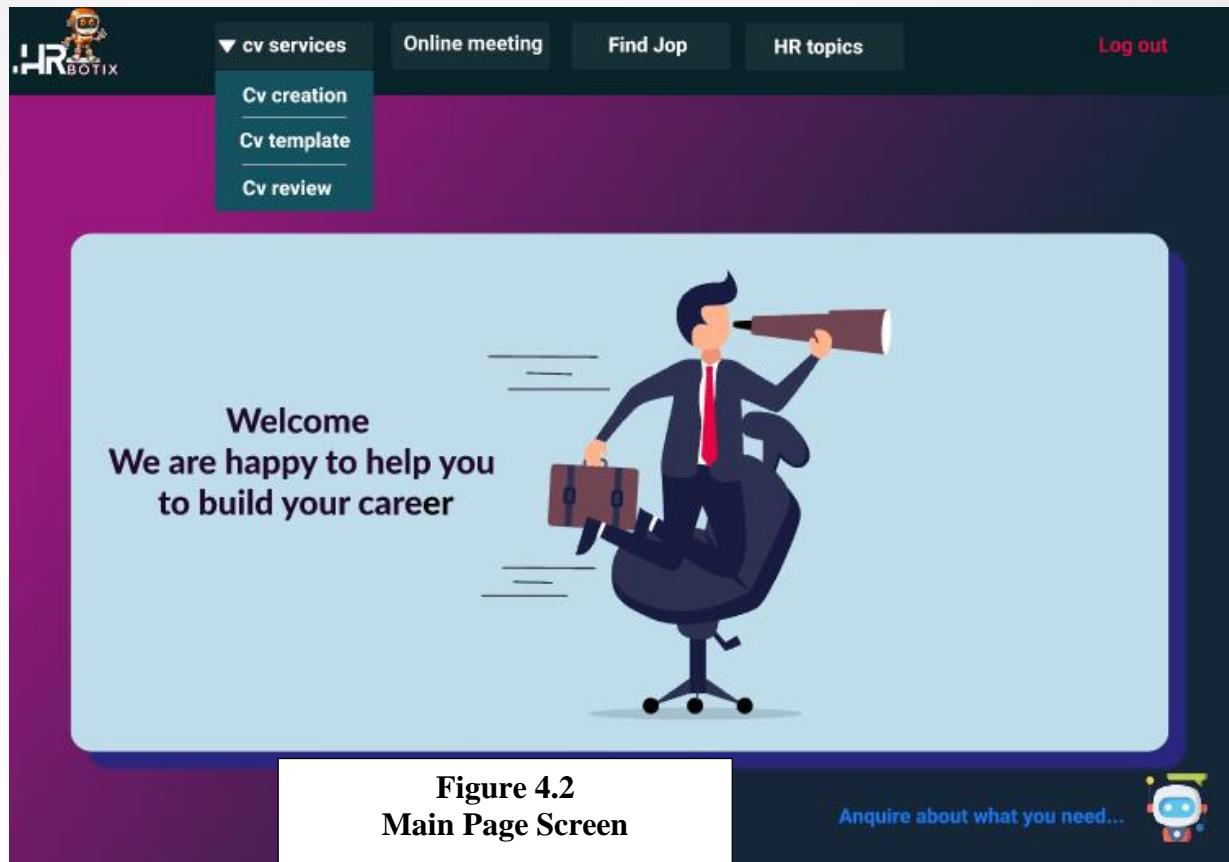


Figure 4.2  
Main Page Screen

## 4.3.2 Chatbot Screen

This page can provide immediate support and answer users' inquiries.

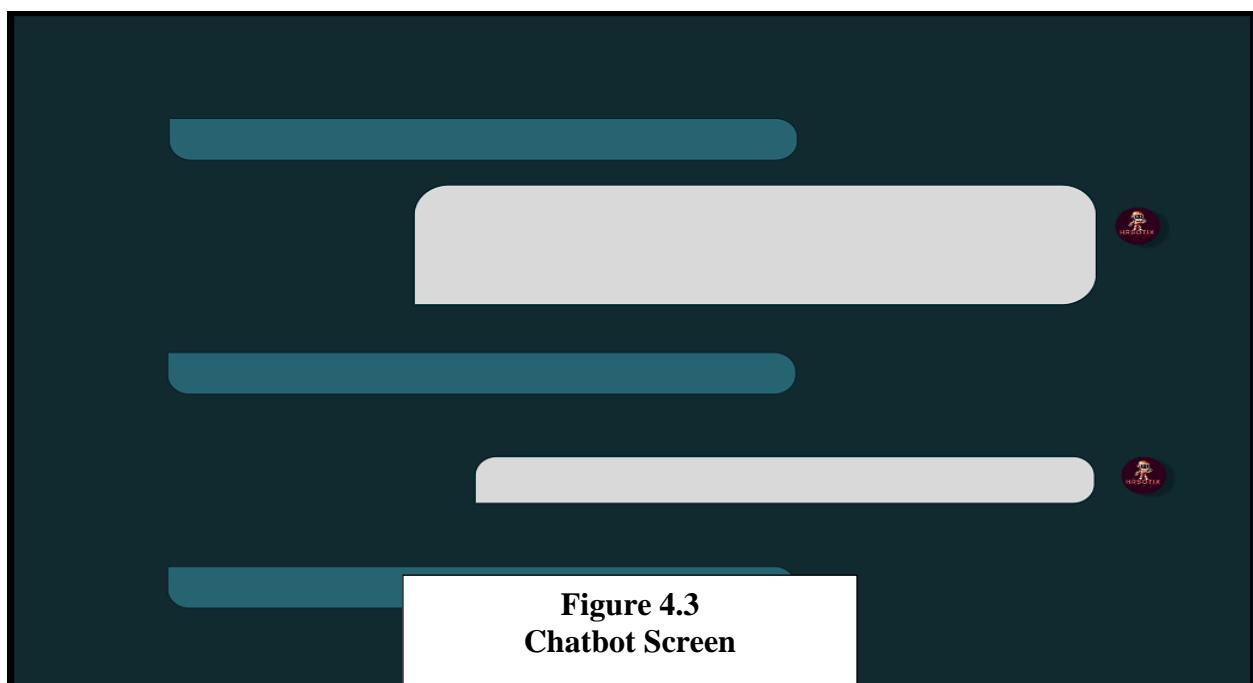


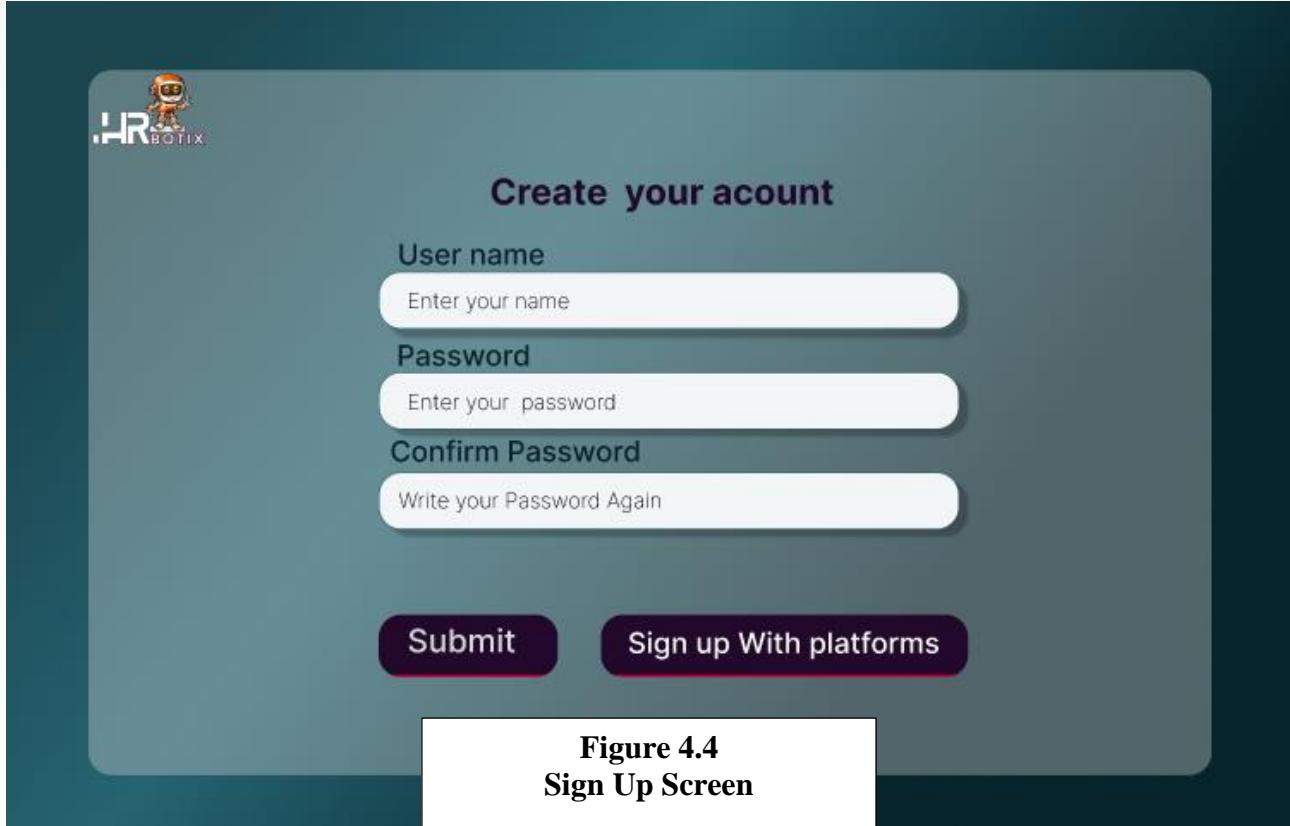
Figure 4.3  
Chatbot Screen

# CH.4 System DESIGN



## 4.3.3 Sign Up Screen

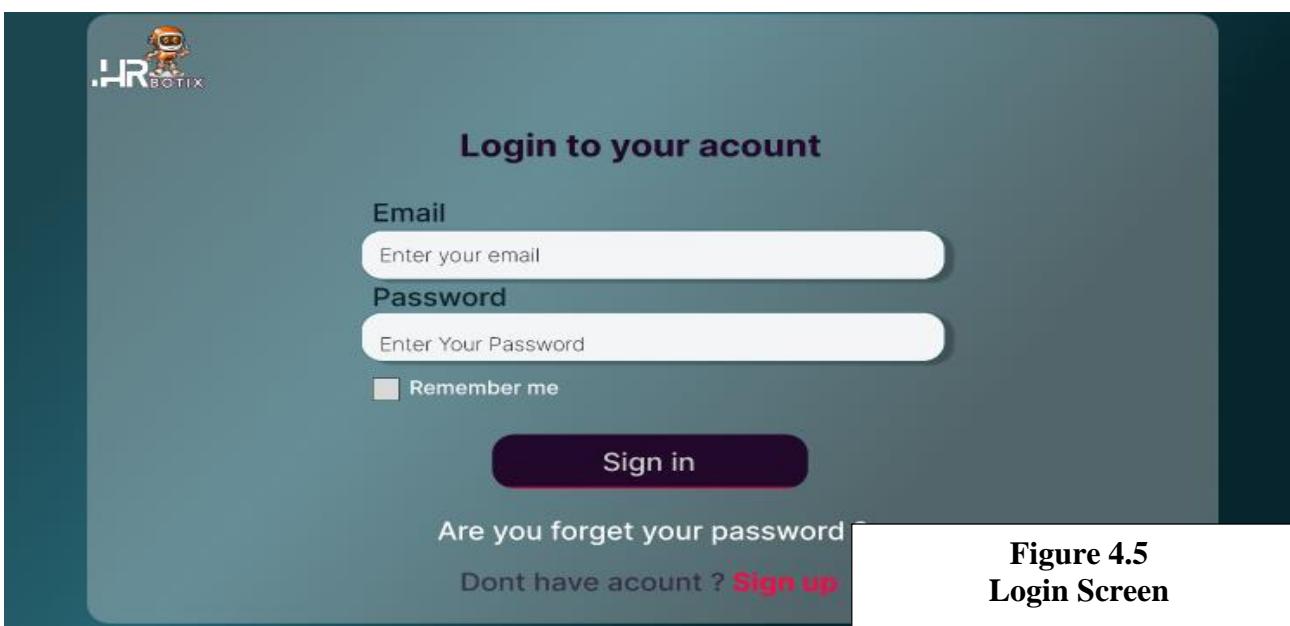
This page can help user in creating an account on our website.



The image shows the 'Create your account' form. It features a logo in the top-left corner. The form has four input fields: 'User name' (placeholder: 'Enter your name'), 'Password' (placeholder: 'Enter your password'), 'Confirm Password' (placeholder: 'Write your Password Again'), and a 'Submit' button. Below the form is a 'Sign up With platforms' button. A callout box in the bottom-right corner identifies the screen as 'Figure 4.4 Sign Up Screen'.

## 4.3.4 Login Screen

This page can help user to sign in his account on our website.



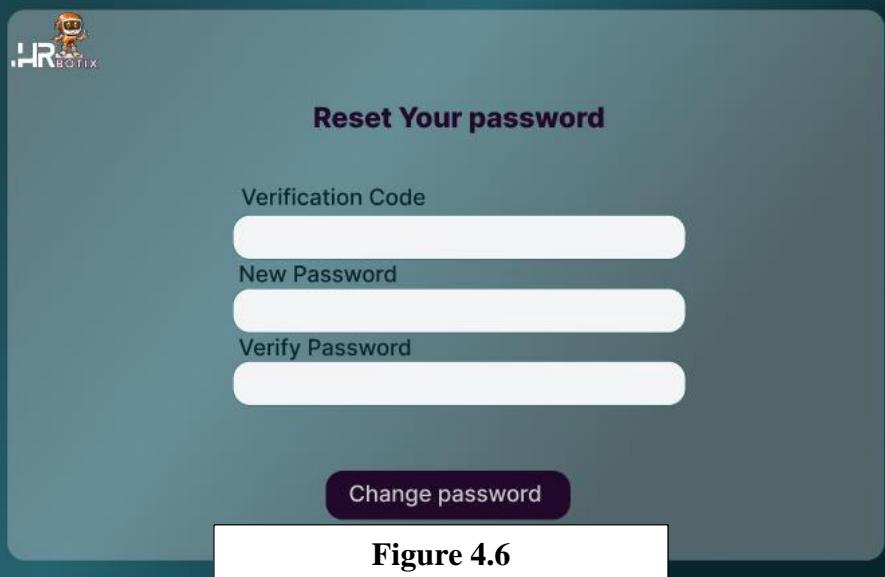
The image shows the 'Login to your account' form. It includes an 'Email' field (placeholder: 'Enter your email'), a 'Password' field (placeholder: 'Enter Your Password'), and a 'Remember me' checkbox. A 'Sign in' button is located below the fields. At the bottom, there are links for 'Are you forget your password?' and 'Dont have account? [Sign up](#)'. A callout box in the bottom-right corner identifies the screen as 'Figure 4.5 Login Screen'.

# CH.4 System DESIGN



## 4.3.5 Reset Password Screen

This page can help user to reset his password in case of forgetting it.

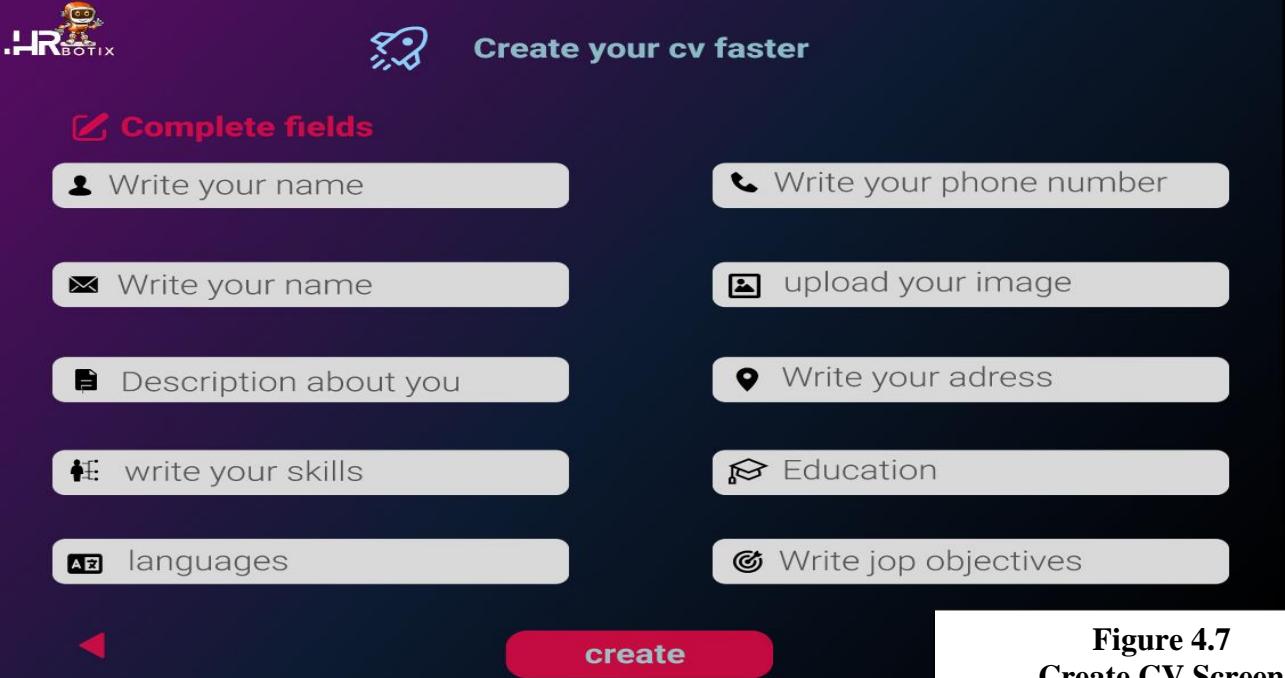


The image shows a mobile application screen titled "Reset Your password". At the top left is the HR Botix logo. Below the title are three input fields: "Verification Code", "New Password", and "Verify Password", each with a placeholder text. A "Change password" button is located below the input fields. The background is a dark teal color.

**Figure 4.6**  
**Reset Password Screen**

## 4.3.6 Create CV Screen

The Create CV page includes a form through which the user can enter his information, such as username, inclination, personal skills, language, mobile number, personal photo, address, level of education, and job title. The form also includes options for the user to create CV or return to the previous page.



The image shows a mobile application screen titled "Create your cv faster". At the top left is the HR Botix logo. The screen is divided into two columns of input fields. The left column includes fields for "Complete fields" (Write your name, Write your name, Description about you, write your skills, languages), and the right column includes fields for "Create your cv faster" (Write your phone number, upload your image, Write your address, Education, Write job objectives). A "create" button is at the bottom center. The background is a dark purple color.

**Figure 4.7**  
**Create CV Screen**

### 4.3.7 CV Template Screen

The CV Template page includes a form through which the user can choose the template he wants. The form includes options such as the Choose CV Template button, return to the previous page.



Figure 4.8  
CV Template Screen

### 4.3.8 CV Review Screen

The CV Review page contains a form through which the user can upload his CV in order to obtain a rating in order to know whether his CV is good or not good. The form includes options such as a button Get CV Review, return to previous page.

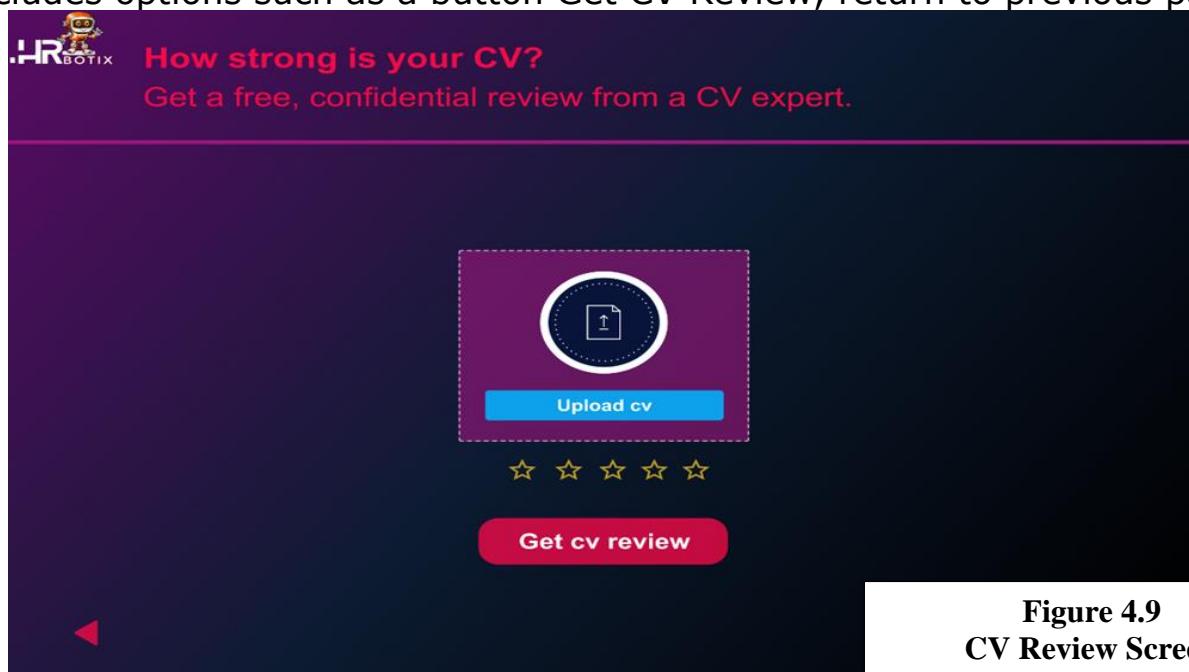
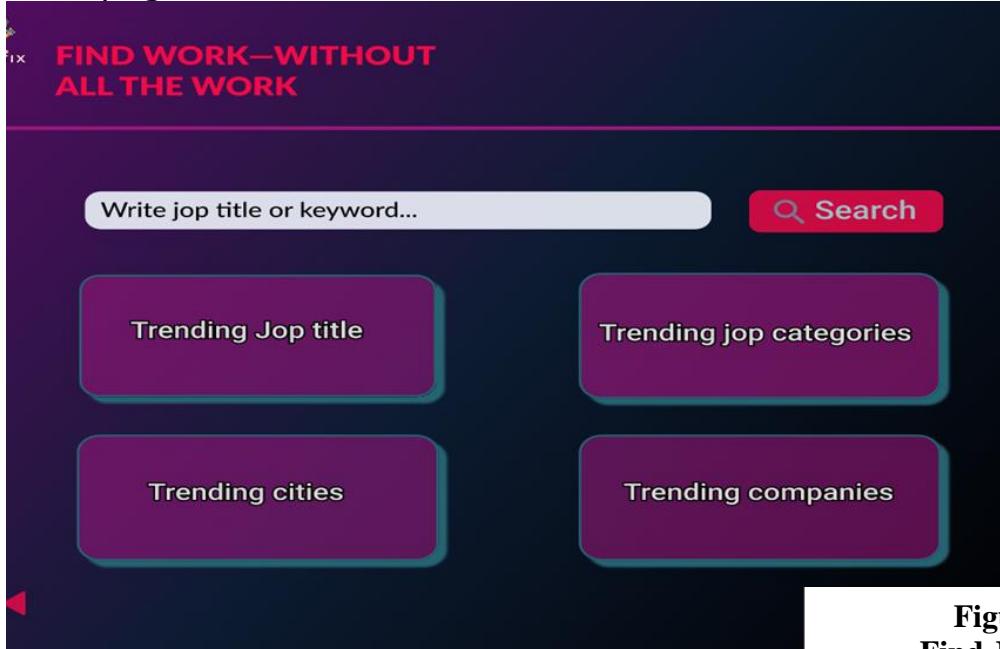


Figure 4.9  
CV Review Screen

#### 4.3.9 Find Job Screen

The Find Job page includes a form through which the user can enter information about the job he wants to search for. The form includes options such as trending job title, trending job categories, trending cities, trending companies, search button, and return to previous page button.

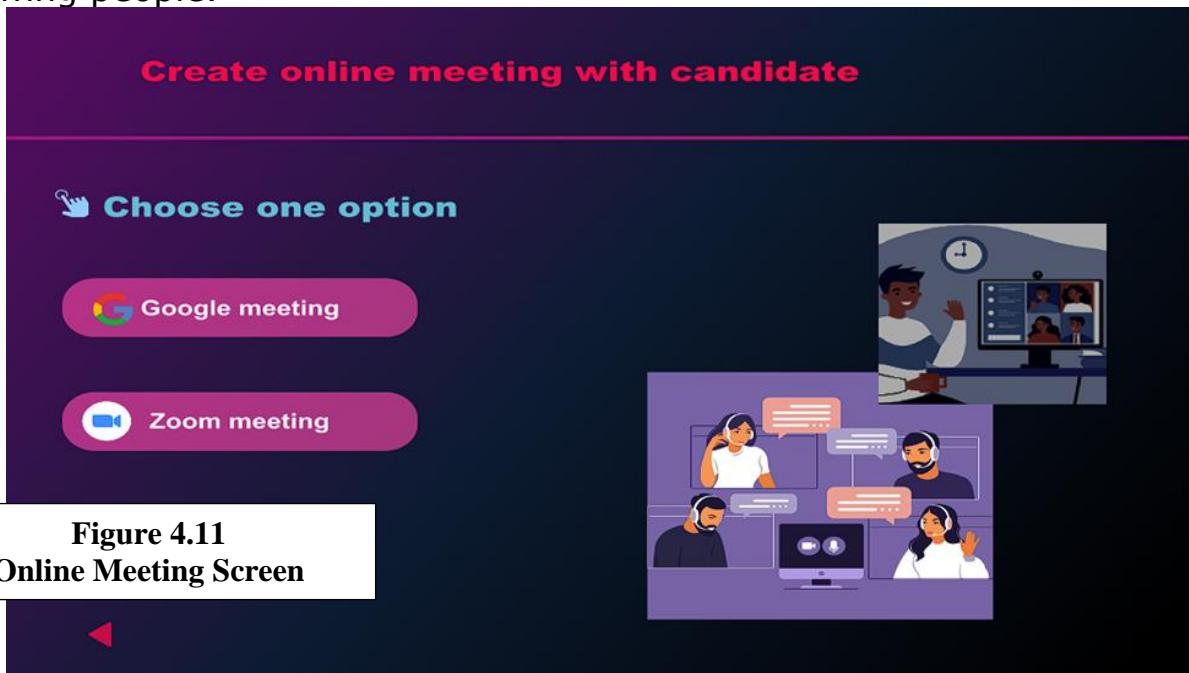


The interface is titled 'FIND WORK—WITHOUT ALL THE WORK'. It features a search bar with the placeholder 'Write job title or keyword...' and a 'Search' button with a magnifying glass icon. Below the search bar are four rounded rectangular buttons: 'Trending Job title', 'Trending job categories', 'Trending cities', and 'Trending companies'. A small red arrow is located on the left side of the screen.

Figure 4.10  
Find Job Screen

#### 4.3.10 Online Meeting Screen

This page creates meetings using Zoom or Google Meeting for the purpose of interviewing people.



The interface is titled 'Create online meeting with candidate'. It has a section titled 'Choose one option' with two buttons: 'Google meeting' and 'Zoom meeting'. To the right of the buttons are two small illustrations: one showing a person in a video conference and another showing four people in a video call. A small red arrow is located at the bottom left of the screen.

Figure 4.11  
Online Meeting Screen



## 4.3.11 Important Topics Screen

The Important Topics page contains the area of employment and developing employees, the area of payroll and performance management, and the area of public relation management.



Figure 4.12  
Important Topics Screen

## 4.4 Input and Output Design

### 4.4.1 Sign Up Page

Process:

- Users input their registration details, including username, email, and chosen password.
- The "Confirm Password" field helps ensure accuracy in password entry.
- Users select their role category from options like Job Seeker, HR, or Businessman.
- Upon successful signup, user information is stored securely in the system's database.

# CH.4 System DESIGN



For example, Job Seekers Sign Up: Individuals actively seeking job opportunities. They'll have access to features tailored to job searching, application tracking, and AI-enhanced feedback.

**Input** → Valid job seeker's username, email, and password.

Create your account

User name  
hossam sayed

Email  
hodsadfas@gmail.com

Password  
\*\*\*\*\*

Confirm Password  
\*\*\*\*\*

Role  
 job seeker  HR  businessman

Submit Sign up With platforms

Figure 4.13  
Input Design for Sign Up Page

**Output** → Redirect to CV review page.

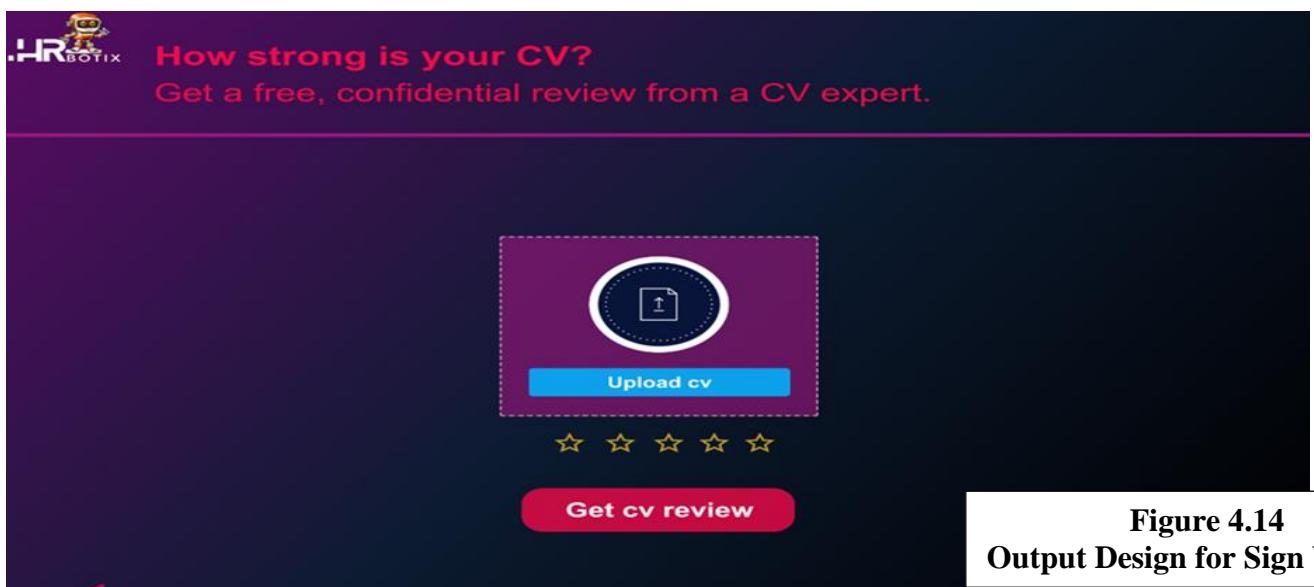


Figure 4.14  
Output Design for Sign Up Page

# CH.4 System DESIGN



## 4.4.2 Login Page

**Input** → Valid job seeker's username and password.

Figure 4.15  
Input Design for Login Page

**Output** → Redirect to his/her profile.

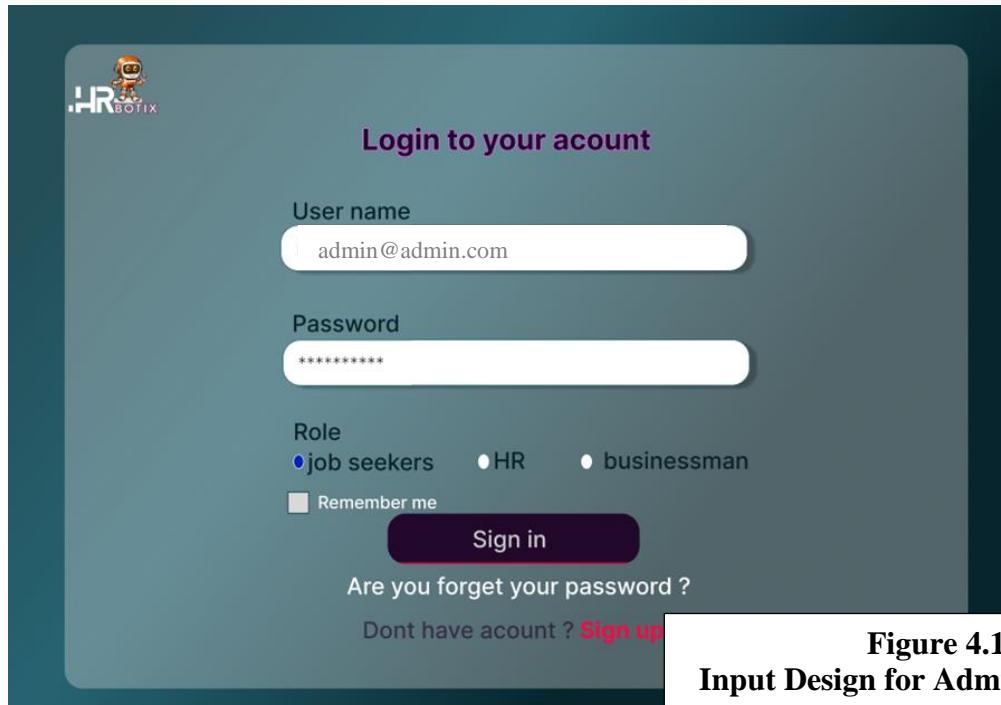
Figure 4.16  
Output Design for Login Page

# CH.4 System DESIGN



## 4.4.3 Login Page for Admin

**Input** → Valid admin's email and password.

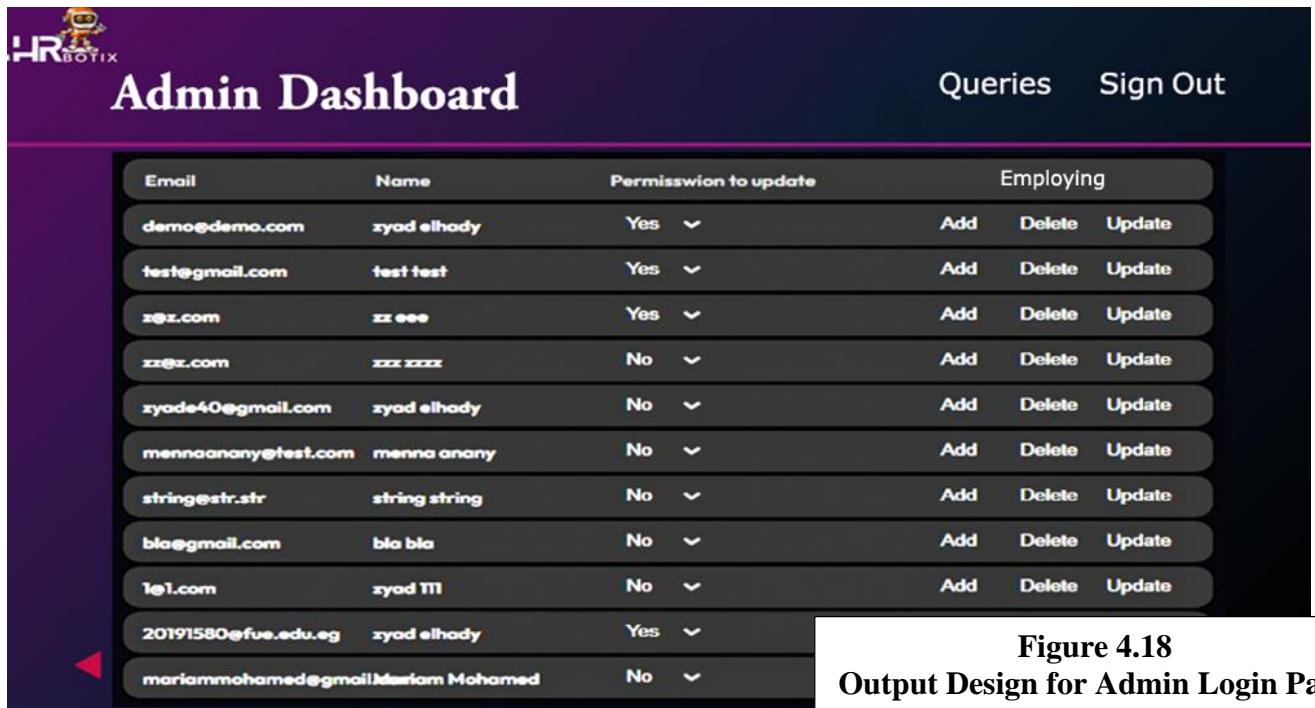


The image shows the 'Login to your account' page for an HR system. It features a logo in the top left corner. The main form has 'User name' and 'Password' fields, both containing placeholder text. Below these are 'Role' and 'Remember me' options, with 'job seekers' selected. A 'Sign in' button is centered at the bottom. Below the button are links for password recovery and sign up.

Email	Name	Permisswion to update	Employing
demo@demo.com	zyad elhady	Yes	Add Delete Update
test@gmail.com	test test	Yes	Add Delete Update
z@z.com	zz eee	Yes	Add Delete Update
zz@z.com	zzz zzzz	No	Add Delete Update
zyade40@gmail.com	zyad elhady	No	Add Delete Update
mennaanany@test.com	menna anany	No	Add Delete Update
string@str.str	string string	No	Add Delete Update
bla@gmail.com	bla bla	No	Add Delete Update
1@1.com	zyad III	No	Add Delete Update
20191580@fue.edu.eg	zyad elhady	Yes	Add Delete Update
mariammohamed@gmail.com	Mariam Mohamed	No	

Figure 4.17  
Input Design for Admin Login Page

**Output** → Redirect to his/her dashboard.



The image shows the 'Admin Dashboard' page. It features a logo in the top left corner and navigation links for 'Queries' and 'Sign Out' in the top right. The main content is a table listing user data with 'Add', 'Delete', and 'Update' buttons for each row.

Email	Name	Permisswion to update	Employing
demo@demo.com	zyad elhady	Yes	Add Delete Update
test@gmail.com	test test	Yes	Add Delete Update
z@z.com	zz eee	Yes	Add Delete Update
zz@z.com	zzz zzzz	No	Add Delete Update
zyade40@gmail.com	zyad elhady	No	Add Delete Update
mennaanany@test.com	menna anany	No	Add Delete Update
string@str.str	string string	No	Add Delete Update
bla@gmail.com	bla bla	No	Add Delete Update
1@1.com	zyad III	No	Add Delete Update
20191580@fue.edu.eg	zyad elhady	Yes	Add Delete Update
mariammohamed@gmail.com	Mariam Mohamed	No	

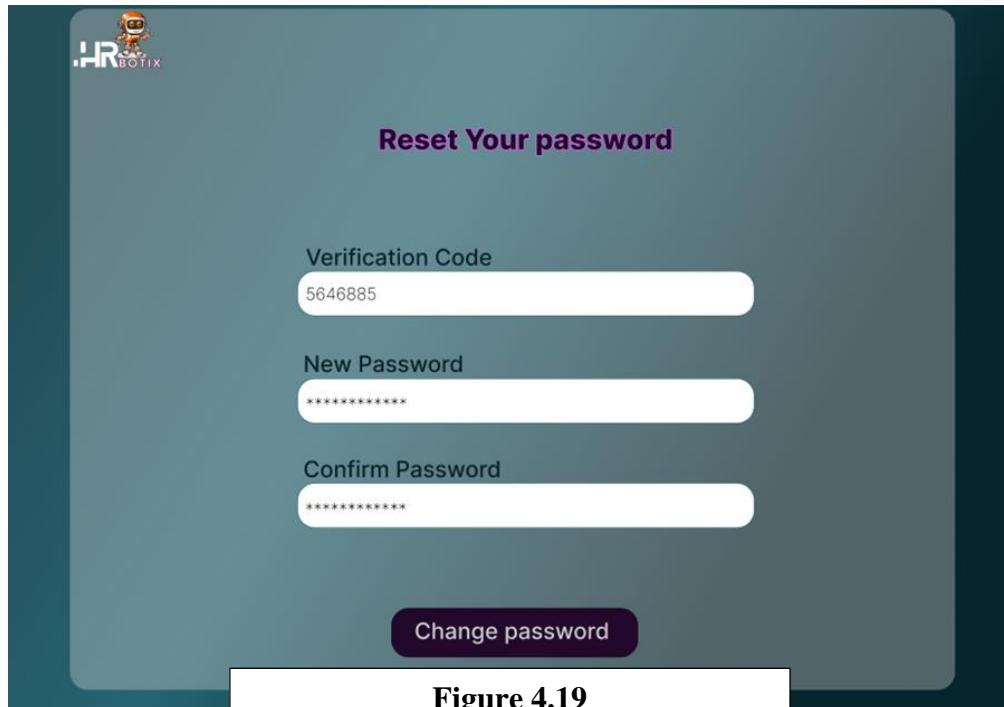
Figure 4.18  
Output Design for Admin Login Page

# CH.4 System DESIGN



## 4.4.4 Reset Password Page

**Input** → Valid verification code and new password.  
**Output** → The system will reset password automatically.



The image shows a mobile-style interface for resetting a password. At the top, there is a logo for 'HR BOTIX' with a small orange robot icon. Below the logo, the title 'Reset Your password' is centered. The page has a dark teal background. There are three input fields: 'Verification Code' containing '5646885', 'New Password' containing '\*\*\*\*\*', and 'Confirm Password' also containing '\*\*\*\*\*'. At the bottom, there is a purple button labeled 'Change password'.

Figure 4.19  
I/O Design for Reset Password Page

## 4.5 Error handling and Exception Design

We apply the validation for pages that needs data to be entered correctly in the format we introduced in our code when the user enters invalid data a message appears to help the user to write it with the valid format by using a user-friendly message approach.

A user-friendly message approach for handling errors is a method of presenting error messages to users in a clear, concise, and supportive way that helps them quickly understand the problem and take the necessary steps to correct it.

This approach involves using simple language, avoiding technical jargon, providing specific and actionable steps, and being friendly and supportive in tone. The goal is to minimize user frustration and confusion when an error occurs and guide them toward a solution.

# CH.4 System DESIGN



## 4.5.1 Sign Up

### ➤ Clicking Signup Without Information:

**Description:** If users click the signup button without providing any information, it's treated as an incomplete action.

**Exception Handling:** Display a message indicating that all required fields must be filled in for successful signup.

Figure 4.20  
Exception Handling for submitting without info

### ➤ Invalid (Sign Up) Username:

**Description:** If users enter an invalid username (e.g., special characters not allowed), it's considered an error.

**Exception Handling:** Inform users that the provided username is invalid, guiding them to enter a valid username.

Figure 4.21  
Exception Handling for Invalid (Sign Up) Username

# CH.4 System DESIGN



## ➤ Invalid (Sign Up) Email:

**Description:** If users enter an invalid email format (e.g., missing '@' symbol), it's considered an error.

**Exception Handling:** Inform users that the provided email format is invalid, guiding them to enter a correct email address.

The screenshot shows a sign-up form with an 'Email' input field. The user has entered 'hosjjkskj.com'. Below the input field, a red error message box displays the text 'please enter valid email'.

Figure 4.22  
Exception Handling for Invalid (Sign Up) Email

## ➤ Invalid (Sign Up) Password:

**Description:** If users set a password that does not meet security requirements (e.g., minimum length, special characters), it's considered an error.

**Exception Handling:** Notify users about the password requirements and provide guidance on creating a secure password.

The screenshot shows a sign-up form with a 'Password' input field. The user has entered '\*\*\*\*'. Below the input field, a red error message box displays the text 'please enter valid password'.

Figure 4.23  
Exception Handling for Invalid (Sign Up) Password

## ➤ (Sign Up) Password Matching:

**Description:** If the "Password" and "Confirm Password" fields do not match, the system identifies the mismatch.

**Exception Handling:** Display a message indicating the mismatch and guide users to ensure password consistency.

The screenshot shows a sign-up form with 'Password' and 'Confirm Password' input fields, both containing '\*\*\*\*\*'. Below the fields, a red error message box displays the text 'password and confirm password not matching'. At the bottom, there is a 'Role' section with radio buttons for 'job seeker', 'HR', and 'businessman', and two 'Submit' buttons.

Figure 4.24  
Exception Handling for  
(Sign Up) Password  
Matching

#### 4.5.2 Login

➤ **Clicking Login Without Information:**

**Description:** If users click the login button without providing any information, it's treated as an incomplete action.

**Exception Handling:** Display a message indicating that both the username/email and password fields must be filled in for a successful login.

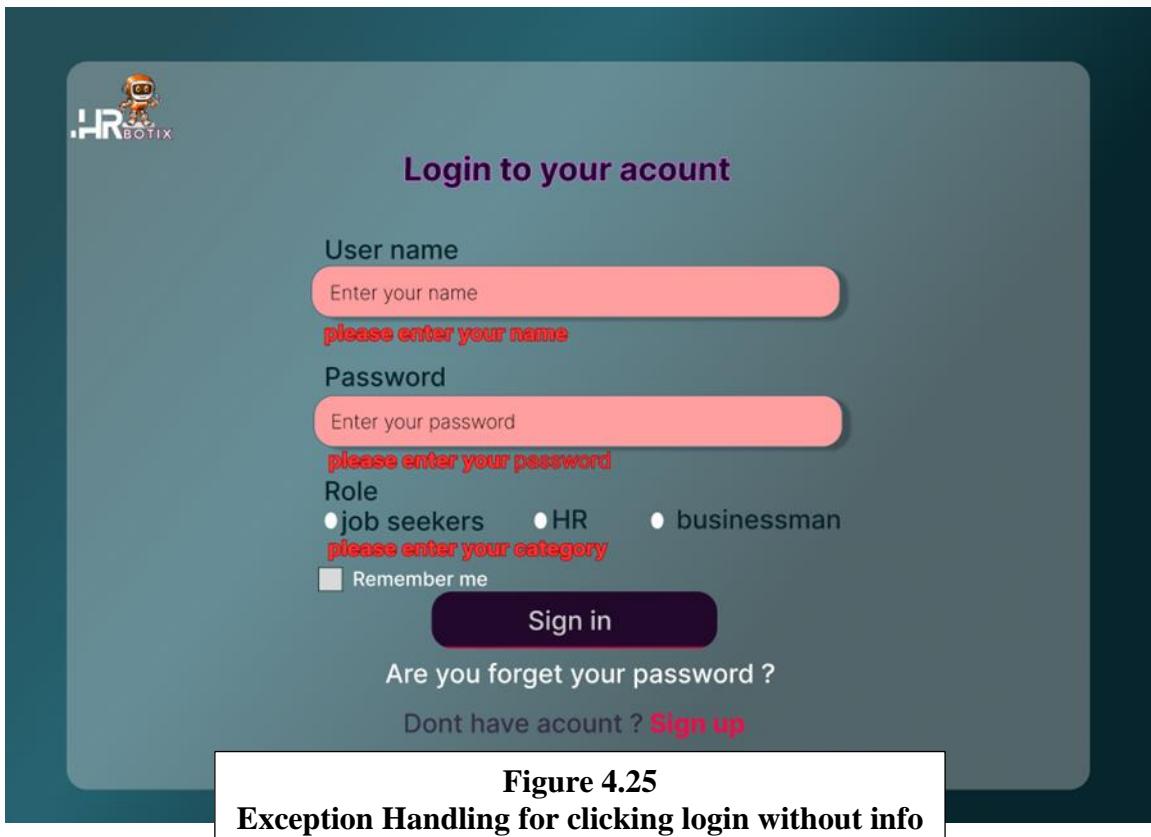


Figure 4.25  
Exception Handling for clicking login without info

➤ **Invalid (Login) Username:**

**Description:** If users enter an invalid username format, it's considered an error.

**Exception Handling:** Inform users that the provided username format is invalid, guiding them to enter a correct username.

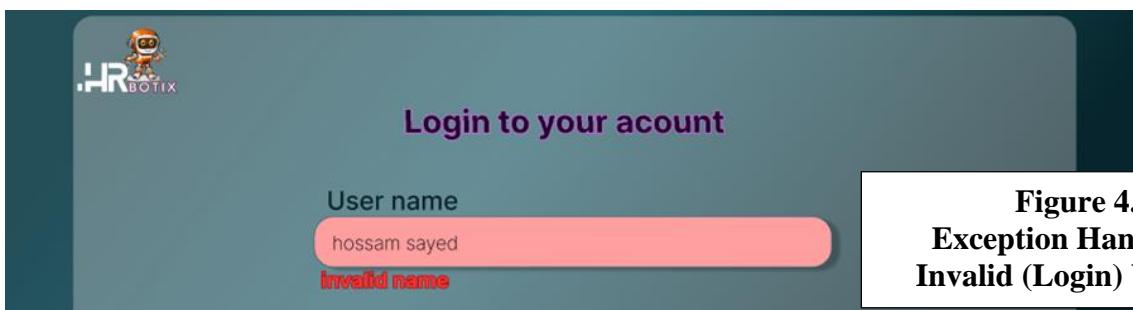


Figure 4.26  
Exception Handling for Invalid (Login) Username

# CH.4 System DESIGN



## ➤ Invalid (Login) Password:

**Description:** If users provide an invalid password (e.g., doesn't meet security requirements), it's considered an error.

**Exception Handling:** Notify users about the password requirements and guide them to enter a correct password.

A screenshot of a login interface. The 'Password' field contains four asterisks. Below the field, the text 'invalid password' is displayed in red.

Figure 4.27  
Exception Handling for Invalid (Login) Password

## ➤ Inactive and invalid Accounts:

**Description:** If users attempt to log in with an inactive or suspended account, it's considered an error.

**Exception Handling:** Notify users that their account is inactive or suspended, guiding them to contact support for assistance.

A screenshot of a login interface. The 'User name' field contains 'hossam sayed'. The 'Password' field contains four asterisks. Below the 'Password' field, the text 'invalid account' is displayed in red.

Figure 4.28  
Exception Handling for Inactive and invalid Accounts

## 4.5.3 Reset Password

### ➤ Invalid Verification Code:

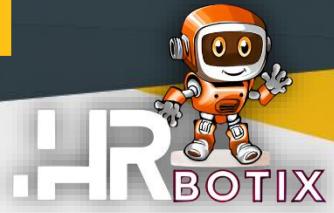
**Description:** If users enter an incorrect or expired verification code, it's considered an error.

**Exception Handling:** Notify users that the verification code is invalid or has expired, guiding them to request a new one if needed.

A screenshot of a verification code input interface. The 'Verification Code' field contains '5646885tgfytf'. Below the field, the text 'invalid verification code' is displayed in red.

Figure 4.29  
Exception Handling for  
Invalid Verification Code

# CH.4 System DESIGN



## ➤ Password Complexity Issues:

**Description:** If users attempt to set a password that doesn't meet the system's complexity requirements, it's considered an error.

**Exception Handling:** Inform users about the password requirements and guide them to set a password that meets the criteria.

Figure 4.30  
Exception Handling for Password Complexity Issues

## ➤ Password Matching:

**Description:** If the "Password" and "Confirm Password" fields do not match, the system identifies the mismatch.

**Exception Handling:** Display a message indicating the mismatch and guide users to ensure password consistency.

Figure 4.31  
Exception Handling for Password Matching

## 4.6 Summary

This chapter delves into the crucial System Design phase, where the identified requirements are meticulously transformed into a comprehensive System Design Document. This document acts as a roadmap for the subsequent development phase, detailing the system's functionalities, attributes, and interactions to ensure alignment with the initial requirements.

Moreover, the chapter extensively explores User Interface Design principles, emphasizing the importance of creating intuitive and user-friendly interfaces. Various screens such as Sign Up, Login, Reset Password, Create CV, Chatbot, CV Template, CV Review, and Important Topics are highlighted, each playing a vital role in enhancing user engagement and system usability. By incorporating design considerations like usability, accessibility, and responsiveness, the interface aims to cater to diverse user needs across different devices and screen sizes, ultimately optimizing the user experience.

# CH.5 Implementation



## 5.1 Introduction

Now that we have clarified the steps that our model should follow, we will explain in depth each of these steps during the implementation phase.

Implementation in machine learning refers to the process of developing, training, and deploying a machine learning model for a specific task or application. The implementation process involves several steps: data preprocessing, model selection, training, evaluation, and deployment. This ensures the model effectively learns from data and performs accurately in real-world scenarios.

## 5.2 Gathering Data

### 5.2.1 Obtaining and training data

#### Import Clean Dataset

**Figure 5.1**  
Data importing after collection

```
In [2]: df = pd.read_csv('UpdatedResumeDataSet.csv')
clean_df = pd.read_csv('clean_resume_data.csv')
resume = pd.read_csv('Resume.csv')

In [3]: clean_df['Category'].value_counts()
Out[3]: INFORMATION-TECHNOLOGY    120
BUSINESS-DEVELOPMENT      120
FINANCE                  118
```

#### ▽ CV Dataset:

- **Dataset Source:** Kaggle
- **Description:** The dataset provides detailed information about software developers' employment, education, languages, and compensation.
- **Attributes:**
  - 46 columns covering various aspects such as employment status, education level, programming languages, compensation details, tools, technologies, and demographic information.
- **Dataset Size and Structure:**
  - 83,439 rows
  - 46 columns
  - 29.3+ MB memory usage
  - A mix of numerical and categorical data enriches the analytical potential.
- **Training Dataset:**
  - The dataset includes comprehensive data to train models that can predict employment outcomes, salary estimations, and educational insights.
- **Test Dataset:**
  - A portion of the dataset is reserved for testing to evaluate model performance in real-world scenarios.

# CH.5 Implementation



## ▽ Data Job Posts Dataset:

- **Dataset Source:** Kaggle
- **Description:** This dataset provides insights into job postings, including job titles, companies, locations, and requirements.
- **Attributes:**
  - 24 columns covering job details such as title, company, location, requirements, eligibility criteria, application procedures, salary, and duration.
- **Dataset Size and Structure:**
  - 19,001 rows
  - 24 columns
  - 3.4+ MB memory usage
  - Rich in both numerical and categorical data, ideal for market trend analysis.
- **Training Dataset:**
  - The dataset is used to train models to understand job market trends, role requirements, and eligibility criteria.
- **Test Dataset:**
  - A subset is kept for testing to ensure models perform well on unseen job postings.

## ▽ ChatBot Dataset:

- **Dataset Source:** Created in-house
- **Description:** The dataset focuses on providing responses for various user intents related to job search, CV advice, skill improvement, interview tips, and general greetings.
- **Attributes:**
  - Tags (intent categories)
  - Patterns (user input examples)
  - Responses (bot replies)
  - Context set (contextual information for maintaining conversation flow)
- **Dataset Size and Structure:**
  - 5 intent categories: Greeting, Goodbye, CV Advice, Skill Improvement, Interview Tips, Job Search
  - Patterns and responses list for each intent
  - Relatively compact compared to larger numerical datasets.

# CH.5 Implementation



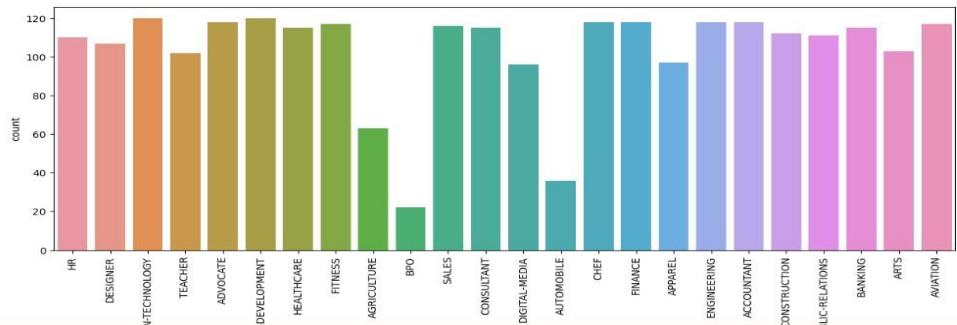
## • **Training Dataset:**

- The dataset includes various patterns and responses to train a chatbot to handle user queries effectively.

## • **Test Dataset:**

- A set of sample queries is reserved for testing to ensure the chatbot provides accurate and helpful responses.

```
In [5]: plt.figure(figsize=(15, 5))
sns.countplot(x=clean_df['Category']) # Note the addition of 'x='
plt.xticks(rotation=90)
plt.show()
```



**Figure 5.2**  
Exploratory Data analysis

## 5.2.2 Data Collection Process:

### 1. CV Dataset:

- **Source:** Downloaded from Kaggle.
- **Preparation:** Data was cleaned and preprocessed, handling missing values, encoding categorical data, and normalizing numerical data.
- **Directory Setup:** The dataset was organized into a structured format for training and testing.

### 2. Data Job Posts Dataset:

- **Source:** Downloaded from Kaggle.
- **Preparation:** Data was preprocessed to handle missing values, encode categorical data, and normalize numerical data.
- **Directory Setup:** The dataset was organized into a structured format, ready for model training and evaluation.

### 3. ChatBot Dataset:

- **Source:** Created in-house.
- **Preparation:** Data was manually curated, ensuring patterns and responses were correctly matched to their intent categories.
- **Directory Setup:** The dataset was organized into directories for each intent category, making it easy to train the chatbot model.

# CH.5 Implementation



## 5.3 Preparing Data

Our model provides so many services using ML algorithms.

- ◆ **The first service is resume parsing consists of 3 main stages:**

- 1- Extracted Info and hiring Process
- 2- Resume Categorization Prediction
- 3- Resume Job Recommendation System

We will take only the part related to the preparing in each stage of the first service

### 1- Preparing data for Extracted Info and hiring Process:

#### ⊕ Extracting Text from Resumes

The first step in resume parsing is to extract the text from resumes in various formats, such as PDF or Word documents. We'll be using the pdfminer.six library to extract text from PDF resumes. Here's a function that takes a PDF file path as input and returns the extracted text:

```
In [1]: import re
from pdfminer.high_level import extract_text

def extract_text_from_pdf(pdf_path):
    return extract_text(pdf_path)

resume_path = "info_resume.pdf"
text = extract_text_from_pdf(resume_path)
text
```

Figure 5.3  
Extracting Text from Resumes

#### ⊕ Extracting Contact Information

Contact information, including phone numbers, email addresses, and physical addresses, is crucial for reaching out to potential candidates. Extracting this information accurately is an essential part of resume parsing. We can use regular expressions to match patterns and extract contact information.

#### - Function to Extract

Let's define a function to extract a contact number from the resume text:

```
import re

def extract_contact_number_from_resume(text):
    contact_number = None

    # Use regex pattern to find a potential contact number
    pattern = r"\b(?:\+\d{1,3}[-.\s]?)?(\d{3}[-.\s]?\d{3}[-.\s]?\d{4})\b"
    match = re.search(pattern, text)
    if match:
        contact_number = match.group()

    return contact_number

phone = extract_contact_number_from_resume(text)
```

Figure 5.4  
-Function to Extract contact number

# CH.5 Implementation



## - Extracting Email Address

In addition to the contact number, extracting the email address is vital for communication with candidates. We can again use regular expressions to match patterns and extract the email address. Here's a function to extract the email address from the resume text:

```
In [3]: import re

def extract_email_from_resume(text):
    email = None

    # Use regex pattern to find a potential email address
    pattern = r"\b[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,}\b"
    match = re.search(pattern, text)
    if match:
        email = match.group()

    return email

email = extract_email_from_resume(text)
email
```

**Figure 5.5**  
-Function to Extract email address

## Extracting Skills

Identifying the skills mentioned in a resume is crucial for determining the candidate's qualifications. We can create a list of relevant skills and match them against the resume text to extract the mentioned skills. Let's define a function to extract skills from the resume text:

```
In [4]: import re

def extract_skills_from_resume(text, skills_list):
    skills = []

    for skill in skills_list:
        pattern = r"\b{}\b".format(re.escape(skill))
        match = re.search(pattern, text, re.IGNORECASE)
        if match:
            skills.append(skill)

    return skills
```

**Figure 5.6**  
- Extracting Skills

## Extracting Education

Education qualifications play a vital role in the recruitment process. We can match specific education keywords against the resume text to identify the candidate's educational background. Here's a function to extract education information from the resume text:

**Figure 5.7**  
- Extracting Education

```
In [5]: import re

def extract_education_from_resume(text):
    education = []

    # List of education keywords to match against
    education_keywords = [
        'Computer Science', 'Information Technology', 'Software Engineering', 'Electrical Engineering',
        'Chemical Engineering', 'Biomedical Engineering', 'Aerospace Engineering', 'Nuclear Engineering'
```

# CH.5 Implementation



## Extracting Name Using spaCy

Identifying the candidate's name from the resume is essential for personalization and identification. We can use spaCy and its pattern matching capabilities to extract the candidate's name. Let's define a function to extract the name using spaCy:

```
In [6]: def extract_name_from_resume(text):
    name = None

    # Use regex pattern to find a potential name
    pattern = r"(\b[A-Z][a-z]+\b)\s(\b[A-Z][a-z]+\b)"
    match = re.search(pattern, text)
    if match:
        name = match.group()

    return name

name = extract_name_from_resume(text)

if name:
    print("Name:", name)
else:
    print("Name not found")
```

Figure 5.8  
- Extracting Name

## 2- Preparing data for Resume Categorization Prediction:

### Balance Dataset

```
In [7]: from sklearn.utils import resample

# Define the maximum count among all categories
max_count = clean_df['Category'].value_counts().max()

# Resample each category to match the maximum count
balanced_data = []
for category in clean_df['Category'].unique():
    category_data = clean_df[clean_df['Category'] == category]
    if len(category_data) < max_count:
        # Perform oversampling for categories with fewer samples
        balanced_category_data = resample(category_data, replace=True, n_samples=max_count, random_state=42)
    else:
        # Perform undersampling for categories with more samples
        balanced_category_data = resample(category_data, replace=False, n_samples=max_count, random_state=42)
    balanced_data.append(balanced_category_data)

# Concatenate the balanced data for all categories
balanced_df = pd.concat(balanced_data)
```

Figure 5.9  
Balance Dataset

The code balances a dataset by resampling each category to match the maximum count among all categories. It oversamples categories with fewer samples and undersamples categories with more samples using resample from sklearn.utils. The balanced data for each category is then concatenated into a single DataFrame. The final balanced dataset is stored in balanced\_df.

# CH.5 Implementation



## 3- Preparing data for Resume Job Recommendation System:

### ⊕ Reading dataset

```
In [1]: import pandas as pd  
In [2]: df = pd.read_csv("jobs_dataset_with_features.csv")  
In [3]: df.shape  
Out[3]: (1615940, 2)
```

```
In [4]: df.head()  
Out[4]:
```

	Role	Features
0	Social Media Manager	5 to 15 Years Digital Marketing Specialist M.T...
1	Frontend Web Developer	2 to 12 Years Web Developer BCA HTML, CSS, Jav...
2	Quality Control Manager	0 to 12 Years Operations Manager PhD Quality c...
3	Wireless Network Engineer	4 to 11 Years Network Engineer PhD Wireless ne...
4	Conference Manager	1 to 12 Years Event Manager MBA Event planning...

Figure 5.10  
Reading dataset

### ⊕ Filtering classes by dropping

```
In [5]: # Dropping classes with less than 6500 instances  
min_count = 6500  
role_counts = df['Role'].value_counts()  
dropped_classes = role_counts[role_counts < min_count].index  
filtered_df = df[~df['Role'].isin(dropped_classes)].reset_index(drop=True)  
  
# Checking the updated role counts  
filtered_df['Role'].value_counts()
```

Figure 5.11  
Filtering classes

The code drops classes with fewer than 6500 instances from the DataFrame. It identifies roles with less than 6500 occurrences, filters them out, and resets the index. Finally, it checks the updated counts of each role in the filtered DataFrame.

```
In [7]: df = filtered_df.sample(n=10000)  
In [8]: df.head()  
Out[8]:
```

	Role	Features
160433	Business Intelligence Analyst	1 to 10 Years Data Analyst BA Data analysis an...
362415	Account Executive	2 to 15 Years Sales Representative M.Tech Sale...
303115	User Experience Designer	5 to 15 Years UX/UI Designer B.Tech User-cente...
258108	Customer Success Manager	5 to 12 Years Customer Support Specialist M.Co...
92488	Event Coordinator	3 to 12 Years Event Planner M.Tech Event plann...

Figure 5.12  
Result after  
Filtering classes

# CH.5 Implementation



## ◆ The second service is CV Job Matching using Doc2Vec:

### ⊕ Preparing data for CV Job Matching

To implement CV Job Matching using Doc2Vec, we start by importing the necessary libraries and loading the job data from a CSV file. We preprocess the data, keeping only the relevant columns, and merge them into a new column called 'data.' Then, we tokenize the words in the 'data' column and tag them with unique identifiers using the TaggedDocument class.

#### 2. Prepare data

This dataset that we trained our model contains current job postings available on the City of New York's official jobs site in 2020. You can follow this link to download: [New York Job Posting Dataset](#)

```
In [42]: # Load data
df = pd.read_csv('./dataset/nyc-jobs-1.csv')
# Check data
df.head()
```

**Figure 5.13**  
Preparing data for CV Job Matching

### ⊕ Keep only some columns to train the model

```
In [44]: df = df[['Business Title', 'Job Description', 'Minimum Qual Requirements', 'Preferred Skills']]
df.head()
```

	Business Title	Job Description	Minimum Qual Requirements	Preferred Skills
0	Account Manager	Division of Economic & Financial Opportunity (...	1. A baccalaureate degree from an accredited ...	Excellent interpersonal and organizationa...

**Figure 5.14**  
Keep only some columns to train the model

### ⊕ Create a new column and merge the values

```
In [45]: # Create a new column called 'data' and merge the values of the other columns into it
df['data'] = df[['Business Title', 'Job Description', 'Minimum Qual Requirements', 'Preferred Skills']]
# Drop the individual columns if you no longer need them
df.drop(['Business Title', 'Job Description', 'Minimum Qual Requirements', 'Preferred Skills'], axis=1, inplace=True)
# Preview the updated dataframe
print(df.head())
```

	data
0	Account Manager Division of Economic & Financi...
1	EXECUTIVE DIRECTOR, BUSINESS DEVELOPMENT The N...
2	Project Specialist Under direct supervision, p...

**Figure 5.15**  
Creating a new column

### ⊕ Tokenize data

We tokenize the words in the 'data' column and tag them with unique identifiers using the TaggedDocument class.

```
In [46]: # Tag data
data = list(df['data'])
tagged_data = [TaggedDocument(words = word_tokenize(_.lower()), tags = [str(i)]) for i, _ in enumerate(data)]
```

**Figure 5.16 Tokenize data**

# CH.5 Implementation



**HR**  
BOTIX

## ♦ The third service is Chatbot:

### ⊕ Preparing data for Chatbot by Loading and Tokenizing data

```
# Load or create training data
try:
    with open("updatedData.pickle", "rb") as f:
        words, labels, training, output = pickle.load(f)
except FileNotFoundError:
    words = []
    labels = []
    docs_x = []
    docs_y = []

# Tokenize and stem the patterns in intents
for intent in data["intents"]:
    for pattern in intent["patterns"]:
        wrds = nltk.word_tokenize(pattern)
        words.extend(wrds)
        docs_x.append(wrds)
        docs_y.append(intent["tag"])
```

**Figure 5.17**  
Loading and Tokenizing data

## 5.4 Choosing a Model

### ♦ The first service is resume parsing:

#### ▽ Choosing the RF model for Resume Categorization Prediction stage:

In this step, the model selection process begins by considering the type of data you are dealing with. Different models are designed to handle specific data types such as images, sound, text, or even 3D images. The choice of the most suitable model depends on the nature of the data.

```
from sklearn.metrics import classification_report
rf_classifier = RandomForestClassifier()
```

**Figure 5.18**  
Choosing RF model

For our specific case, a Random Forest classifier was chosen. Random Forests are specifically designed for tasks involving structured data and are a type of ensemble learning algorithm. Ensemble learning is used because your model operates on a varied dataset, and ensemble methods excel in improving predictive accuracy by combining multiple decision trees. This highlights the difference between traditional machine learning approaches and deep learning.

By selecting a Random Forest model, we can leverage its algorithms tailored for structured data processing and take advantage of the capabilities offered by ensemble learning techniques to effectively analyze your dataset.

# CH.5 Implementation



By implementing a Random Forest classifier, we can effectively handle the task of resume categorization and achieve a high level of accuracy in your predictions. The confusion matrix provides a detailed view of the model's performance across different categories.

## ▽ Choosing the RF model for Resume Job Recommendation System stage:

```
# RandomForestClassifier
rf_classifier = RandomForestClassifier()
rf_classifier.fit(x_train_tfidf, y_train)
```

Figure 5.19  
Choosing RF model

By implementing a Random Forest classifier, you can effectively handle the task of resume job recommendation and achieve a high level of accuracy in your predictions. This model utilizes TF-IDF vectorization to transform textual data into numerical features, making it suitable for processing and analyzing text data within your dataset.

## ♦ The second service is CV Job Matching:

### ▽ Choosing the Doc2Vec model for Job Matching:

```
# Model initialization
model = Doc2Vec(vector_size = 50,
min_count = 5,
epochs = 100,
alpha = 0.001
)

# Vocabulary building
model.build_vocab(tagged_data)
# Get the vocabulary keys
keys = model.wv.key_to_index.keys()
# Print the length of the vocabulary keys
print(len(keys))
```

Figure 5.20  
Choosing Doc2Vec model

The code initializes a Doc2Vec model with specified parameters and builds its vocabulary from tagged\_data. It then retrieves the keys of the vocabulary (unique words) and prints the number of these unique words. This process prepares the model for generating document embeddings.

## ♦ The third service is Chatbot:

### ▽ Choosing the TensorFlow model for Chatbot:

```
# Build the model
tf.compat.v1.reset_default_graph()

net = tflearn.input_data(shape=[None, len(training[0])])
net = tflearn.fully_connected(net, 8)
net = tflearn.fully_connected(net, 8)
net = tflearn.fully_connected(net, len(output[0]), activation="softmax")
net = tflearn.regression(net)
```

Figure 5.21  
Choosing TensorFlow model

# CH.5 Implementation



The code builds a neural network using TFLearn and TensorFlow. It defines the input layer, two hidden fully connected layers with 8 units each, and an output layer with softmax activation. The network is then compiled using regression. After initializing the model, it trains on the training and output data for 1000 epochs with a batch size of 8, showing metrics during training. Finally, the trained model is saved to "updatedModel.tflearn".

## 5.5 Training and Testing

- ♦ **The first service is resume parsing:**

- ▽ Train and test the RF model for Resume Categorization Prediction stage:

### Train-Test Split

```
x = balanced_df['Feature']
y = balanced_df['Category']
X_train, X_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=42)
```

### Encoding (TF-IDF)

```
tfidf_vectorizer = TfidfVectorizer()
X_train_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_tfidf = tfidf_vectorizer.transform(X_test)
```

**Figure 5.22**  
Splitting data for train and test

The code splits the balanced dataset into features (X) and target labels (y). It then performs a train-test split, allocating 80% of the data for training and 20% for testing, with a fixed random state for reproducibility. A TfidfVectorizer is instantiated to convert text data into TF-IDF feature vectors.

The fit\_transform method is applied to the training data to learn the vocabulary and transform the training text into TF-IDF vectors. The transform method is then used on the test data to convert it into TF-IDF vectors using the learned vocabulary from the training set. This process prepares the text data for model training and evaluation.

# CH.5 Implementation



## ▽ Train and test the RF model for Resume Job Recommendation System stage:

```
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score

# Splitting the data into features (X) and target (y)
X = df['Features']
y = df['Role']

# Train-test split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# TF-IDF vectorization
tfidf_vectorizer = TfidfVectorizer()
X_train_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_tfidf = tfidf_vectorizer.transform(X_test)
```

Figure 5.23  
(2) Splitting data for train and test

The code splits the dataset into features (X, the 'Features' column) and target labels (y, the 'Role' column). It then performs a train-test split, with 80% of the data used for training and 20% for testing, and a fixed random state for reproducibility. A TfidfVectorizer is instantiated to convert the text data into TF-IDF feature vectors. The fit\_transform method is applied to the training data to learn the vocabulary and transform the training text into TF-IDF vectors. The transform method is then used on the test data to convert it into TF-IDF vectors using the vocabulary learned from the training set. This process prepares the text data for model training and evaluation.

## ♦ The second service is CV Job Matching:

## ▽ Train and test the Doc2Vec model for Job Matching:

### 5. Train and save the model

Train the model on tagged data.

```
# Train the model
for epoch in range(model.epochs):
    print(f"Training epoch {epoch+1}/{model.epochs}")
    model.train(tagged_data,
                total_examples=model.corpus_count,
                epochs=model.epochs)

model.save('cv_job_maching.model')
print("Model saved")
```

Figure 5.24  
Train the Doc2Vec model

# CH.5 Implementation



```
Training epoch 1/100
Training epoch 2/100
Training epoch 3/100
Training epoch 4/100
Training epoch 5/100
Training epoch 6/100
```

```
Training epoch 99/100
Training epoch 100/100
Model saved
```

The code trains a model for a specified number of epochs, printing the current epoch during each iteration. It trains the model on the tagged\_data for the total number of examples in the corpus. After training, the model is saved to a file named 'cv\_job\_matching.model'. Finally, it prints a message indicating the model has been saved.

## ♦ The third service is Chatbot:

### ▽ Train and test the TensorFlow model for Chatbot:

```
Training Step: 10999 | total loss: 0.06889 | time: 0.046s
| Adam | epoch: 1000 | loss: 0.06889 - acc: 0.9944 -- iter: 80/84
Training Step: 11000 | total loss: 0.06573 | time: 0.051s
| Adam | epoch: 1000 | loss: 0.06573 - acc: 0.9950 -- iter: 84/84
-- 
INFO:tensorflow:C:\Users\motaheda\chatbot_web\updatedModel.tflearn is not in all_model_checkpoint_paths. Manually adding it.
```

**Figure 5.25**  
**Train the TensorFlow model**

## 5.6 Prediction (Recommendation)

## ♦ The first service is resume parsing:

### ▽ RF model Prediction for Resume Categorization stage:

```
# Clean resume
import re
def cleanResume(txt):
    cleanText = re.sub('http\S+\S', ' ', txt)
    cleanText = re.sub('RT|cc', ' ', cleanText)
    cleanText = re.sub('#\S+\S', ' ', cleanText)
    cleanText = re.sub('@\S+', ' ', cleanText)
    cleanText = re.sub('[%s]' % re.escape("""!"#$%&()*+,-./;:<=>?@[\\]^_`{|}~"""), ' ', cleanText)
    cleanText = re.sub(r'[^\x00-\x7f]', ' ', cleanText)
    cleanText = re.sub('\s+', ' ', cleanText)
    return cleanText

# Prediction and Category Name
def predict_category(resume_text):
    resume_text= cleanResume(resume_text)
    resume_tfidf = tfidf_vectorizer.transform([resume_text])
    predicted_category = rf_classifier.predict(resume_tfidf)[0]
    return predicted_category
```

**Figure 5.26**  
**RF model prediction**

# CH.5 Implementation



```
# Example Usage
resume_file = """hr assistant summary hard worker dedicated detailed oriented experienced organized hi
"""

predicted_category = predict_category(resume_file)
print("Predicted Category:", predicted_category)
Predicted Category: HR
```

**Figure 5.27**  
**Example: RF model prediction**

The code defines functions for cleaning and categorizing resumes using a Random Forest classifier. The cleanResume function removes URLs, special characters, and extra whitespace from the text. The predict\_category function cleans the input resume, transforms it into TF-IDF features, and predicts the category using the trained Random Forest model. An example resume text is provided, and the predict\_category function is called to predict and print the category of this resume. This process helps in categorizing resumes based on their content.

## ▽ RF model for Resume Job Recommendation System stage:

```
# Clean resume
import re
def cleanResume(txt):
    cleanText = re.sub('http\S+\s', ' ', txt)
    cleanText = re.sub('RT|cc', ' ', cleanText)
    cleanText = re.sub('#\S+\s', ' ', cleanText)
    cleanText = re.sub('@\S+', ' ', cleanText)
    cleanText = re.sub('[%s]' % re.escape("""!"#$%&()*)+,-./:;<=>?@[\\]^_`{|}~"""), ' ', cleanText)
    cleanText = re.sub(r'[^\x00-\x7f]', ' ', cleanText)
    cleanText = re.sub('\s+', ' ', cleanText)
    return cleanText

# Prediction and Category Name
def job_recommendation(resume_text):
    resume_text = cleanResume(resume_text)
    resume_tfidf = tfidf_vectorizer.transform([resume_text])
    predicted_category = rf_classifier.predict(resume_tfidf)[0]
    return predicted_category
```

**Figure 5.28**  
**RF model Recommendation**

The code defines functions for cleaning and categorizing resumes using a Random Forest classifier for a job recommendation system. The cleanResume function removes URLs, special characters, and extra whitespace from the text. The job recommendation function cleans the input resume, transforms it into TF-IDF features, and predicts the job category using the trained Random Forest model. An example resume text is provided, and the job\_recommendation function is called to predict and print the job category for this resume. This process aids in recommending suitable job categories based on resume content.

# CH.5 Implementation



```
predicted_category = job_recommendation(resume_file)
print("Predicted Category:", predicted_category)
```

```
Predicted Category: User Interface Designer
```

Figure 5.29  
Example: RF model Recommendation

## 5.7 Evaluation & Result

### ◆ The first service is resume parsing:

#### ▽ Evaluation of RF model Prediction for Resume Categorization stage:

```
# Step 4: Accuracy Evaluation
y_pred = rf_classifier.predict(X_test_tfidf)
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
print(classification_report(y_test, y_pred))
```

Figure 5.30
RF model (categorization) Evaluation

	precision	recall	f1-score	support
ACCOUNTANT	0.80	0.95	0.87	21
ADVOCATE	1.00	0.79	0.88	29
AGRICULTURE	0.95	0.78	0.86	23
APPAREL	0.90	0.86	0.88	21
ARTS	1.00	0.59	0.74	22
AUTOMOBILE	1.00	1.00	1.00	19
AVIATION	0.94	0.97	0.95	30
BANKING	1.00	0.78	0.88	23
BPO	1.00	1.00	1.00	15
BUSINESS-DEVELOPMENT	0.52	0.61	0.56	18
CHEF	0.90	0.96	0.93	28
CONSTRUCTION	0.93	1.00	0.96	25
CONSULTANT	0.95	0.58	0.72	31
DESIGNER	0.96	0.86	0.91	28
DIGITAL-MEDIA	0.87	0.95	0.91	21
ENGINEERING	0.84	0.91	0.87	23
FINANCE	0.82	0.67	0.74	21
FITNESS	0.81	0.95	0.88	22
HEALTHCARE	0.85	0.76	0.80	29
HR	0.62	1.00	0.76	21
INFORMATION-TECHNOLOGY	0.68	0.83	0.75	23
PUBLIC-RELATIONS	0.86	0.78	0.82	23
SALES	0.88	0.78	0.82	27
TEACHER	0.70	1.00	0.82	33
accuracy			0.85	576
macro avg	0.86	0.85	0.85	576
weighted avg	0.87	0.85	0.85	576

Figure 5.31
RF model
(categorization)
Result of
Evaluation

# CH.5 Implementation



```
# Confusion Matrix
conf_matrix = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(10, 8))
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues', xticklabels=rf_classifier.classes_, yticklabels=rf_classifier.classes_)
plt.xlabel('Predicted')
plt.ylabel('True')
plt.title('Confusion Matrix')
plt.show()
```

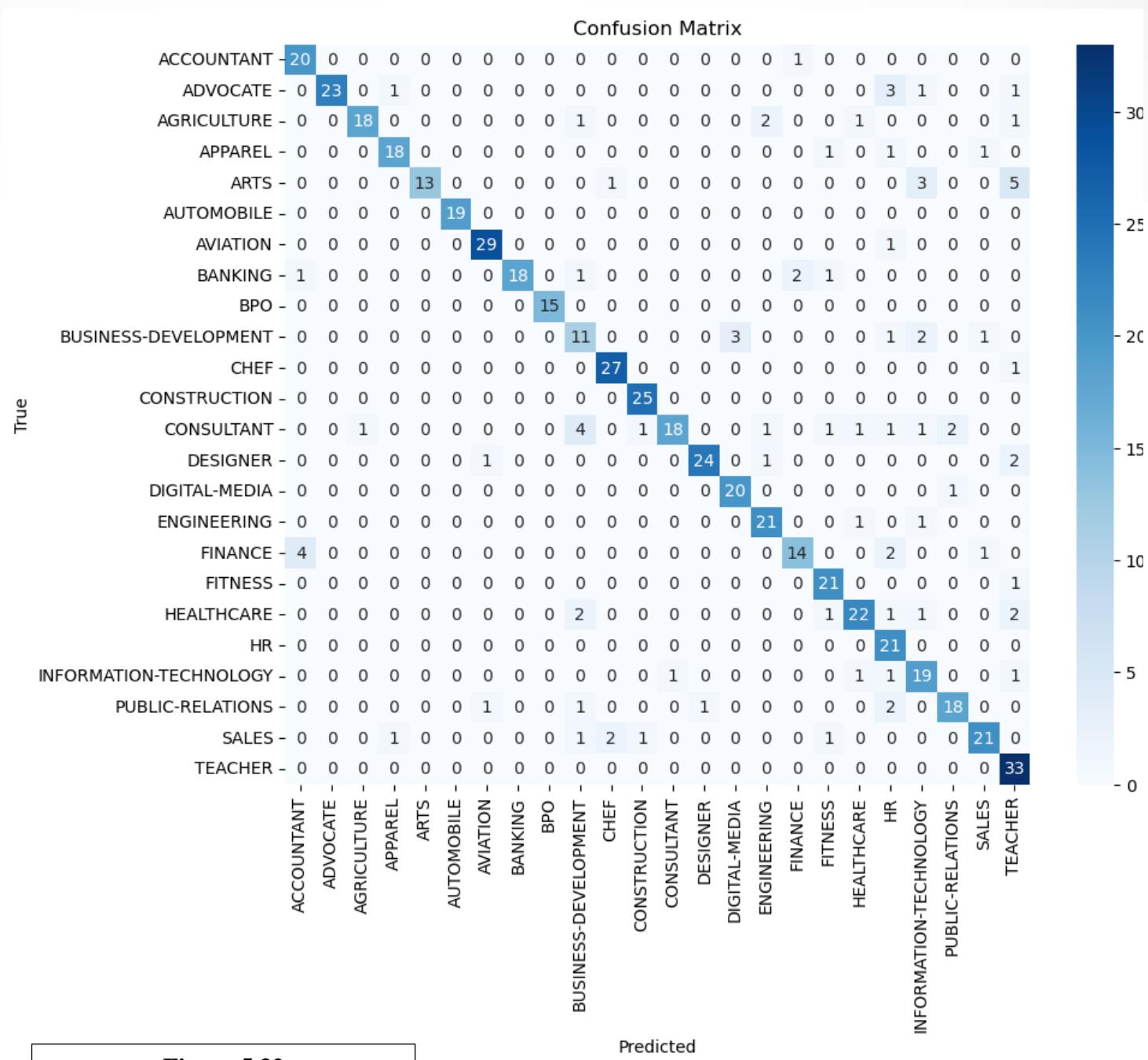


Figure 5.32  
Confusion Matrix

# CH.5 Implementation



## ▽ Evaluation of RF model for Resume Job Recommendation System stage:

```
# Predictions
y_pred = rf_classifier.predict(X_test_tfidf)
```

```
# Accuracy
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

Accuracy: 1.0

**Figure 5.33**  
Accuracy of job recommendation

The code trains a Random Forest classifier using TF-IDF transformed resume data ( $X_{train\_tfidf}$ ,  $y_{train}$ ). It then predicts job categories for the test data ( $X_{test\_tfidf}$ ) and calculates the accuracy of the predictions against the actual categories ( $y_{test}$ ). Finally, it prints the accuracy score, indicating the model's performance in recommending job categories based on resumes.

## ◆ The second service is CV Job Matching:

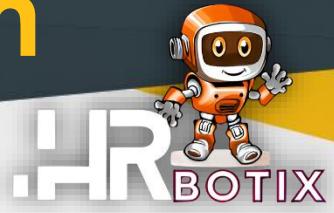
```
# Model evaluation
model = Doc2Vec.load('cv_job_maching.model')
v1 = model.infer_vector(input_CV.split())
v2 = model.infer_vector(input_JD.split())
similarity = 100*(np.dot(np.array(v1), np.array(v2))) / (norm(np.array(v1)) * norm(np.array(v2)))
print(round(similarity, 2))
```

93.28

**Figure 5.34**  
Accuracy of job matching

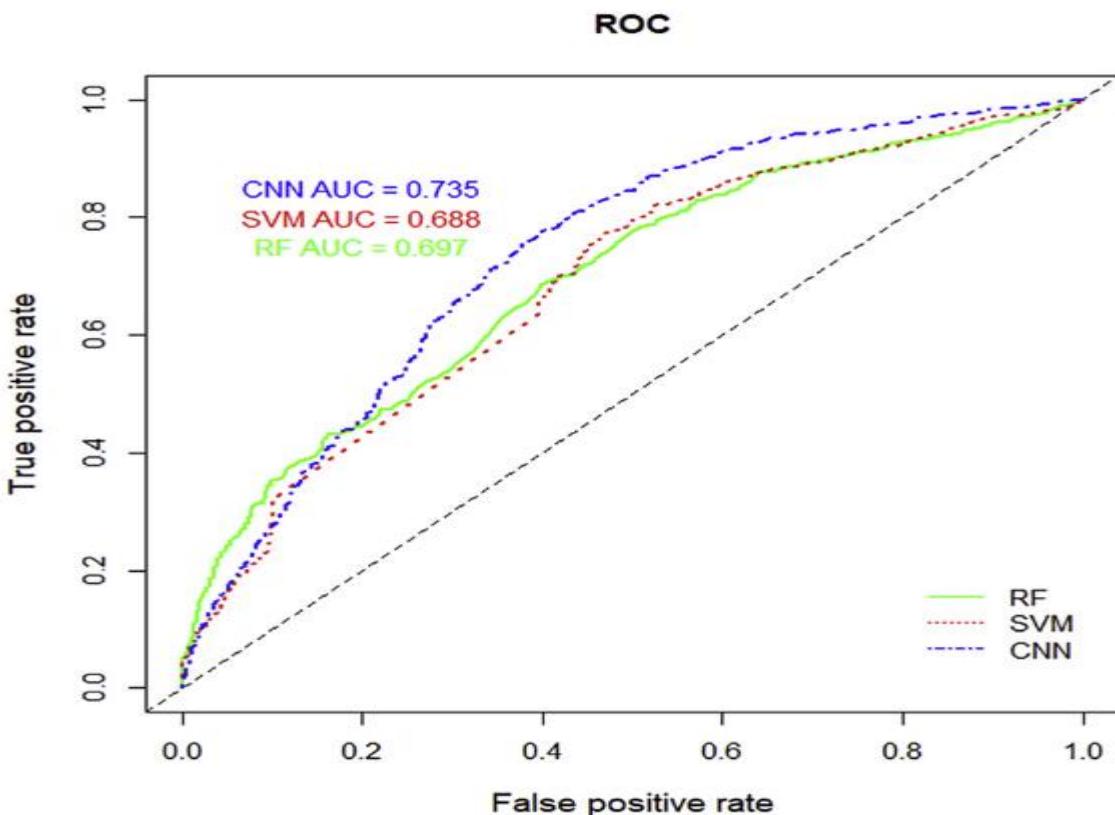
The code loads a pre-trained Doc2Vec model and computes vector representations for the input resume ( $input\_CV$ ) and job description ( $input\_JD$ ). It then calculates the cosine similarity between these vectors, normalizing the dot product to measure their similarity. The similarity score is printed as a percentage, indicating how closely the resume matches the job description. This helps in evaluating the relevance of a resume to a job posting.

# CH.5 Implementation



## 5.8 Comparison between two models

Aspect	Random Forest Classifier	Linear SVM
<b>Algorithm</b>	Ensemble learning (decision trees)	Linear Support Vector Machine (SVM)
<b>Pretrained Model</b>	RF version1	SVM version2
<b>Epochs</b>	4	65
<b>Steps per Epoch</b>	2300	180
<b>Accuracy</b>	Around <b>98.93%</b>	67.98% Depends on tuning, usually high but variable
<b>Time to Get Accuracy</b>	Approximately 3 hours	Approximately 3 hours



Therefore, we chose model number one (RF version1), where the accuracy is more and has the same period of time.

**Figure 5.35**  
**RF Vs SVM Graph**

# CH.5 Implementation



## 5.9 Web Deployment (Web App)



The "Team members" section introduces the team with a clean, organized layout. It features seven members: Hossam Sayed (Front end), Sayed Mohamed (Machine Learning), Robert Kamal (Machine Learning), Amir Salama (Back end), Kerolos Magdy (Back end), Mohamed Sayed (Back end), and Kerolos Medhat (Back end). Each profile includes a photo, name, role, and links to their social media profiles on Facebook, Twitter, Instagram, and YouTube. This section highlights the diverse skills and online presence of the team members.

# CH.5 Implementation



## ○ Main Page

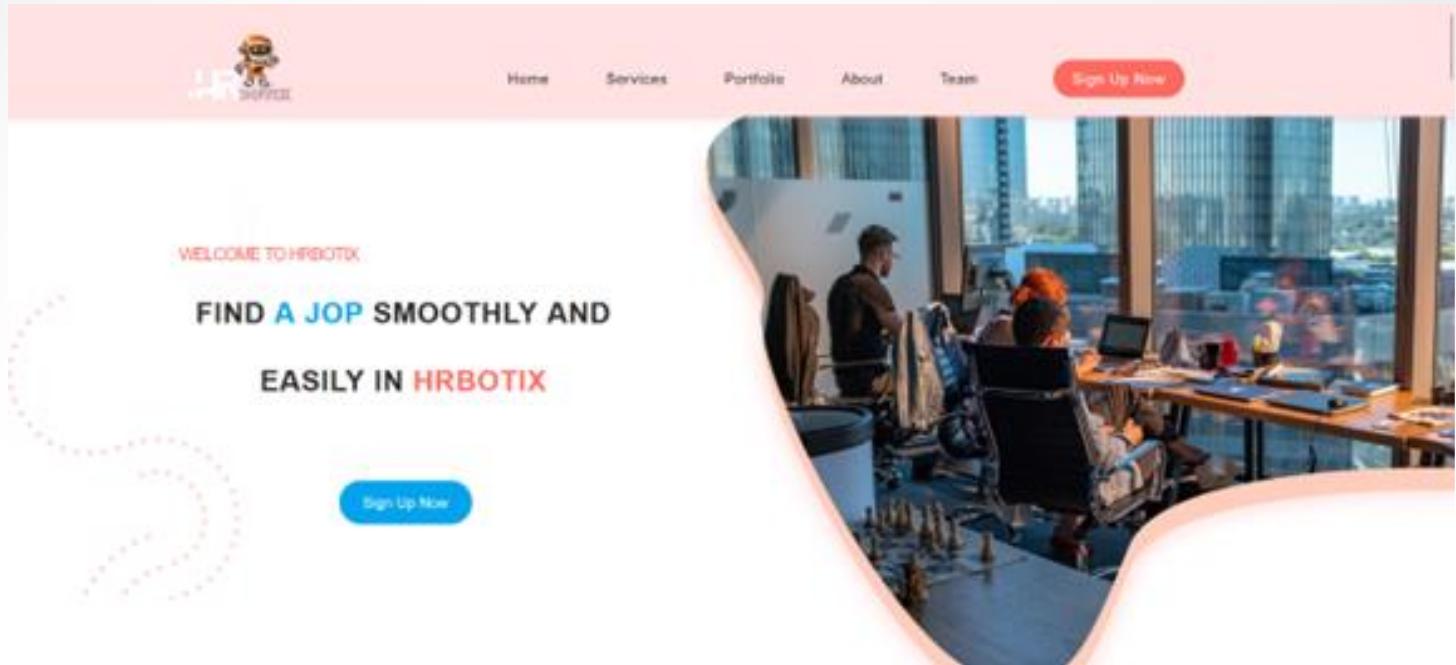


Figure 5.37  
Home

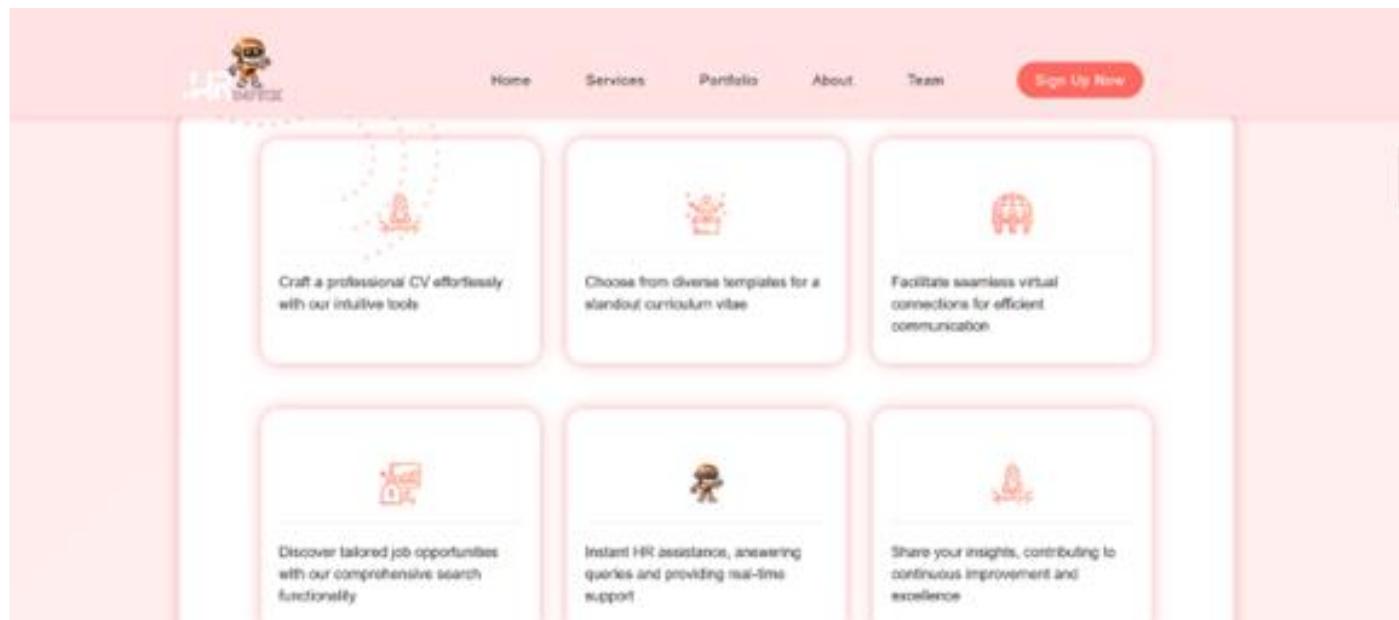


Figure 5.38  
Home

# CH.5 Implementation



## ○ Main Page

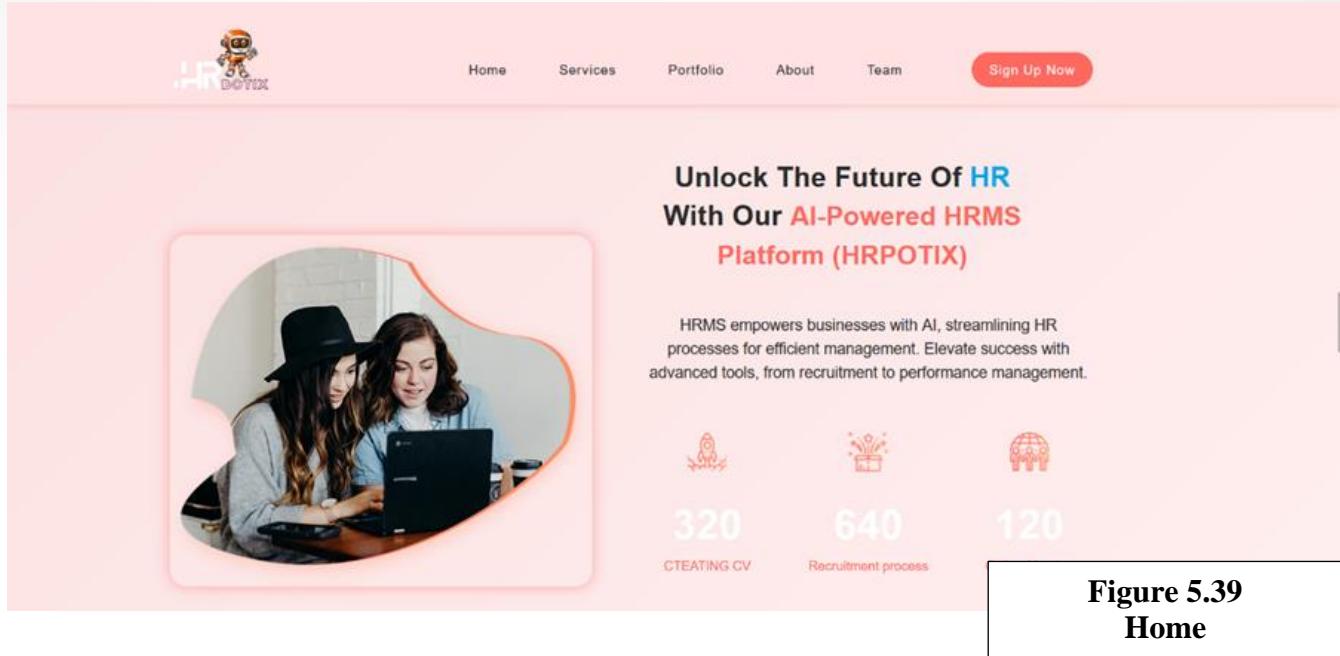


Figure 5.39  
Home



Figure 5.40  
Home

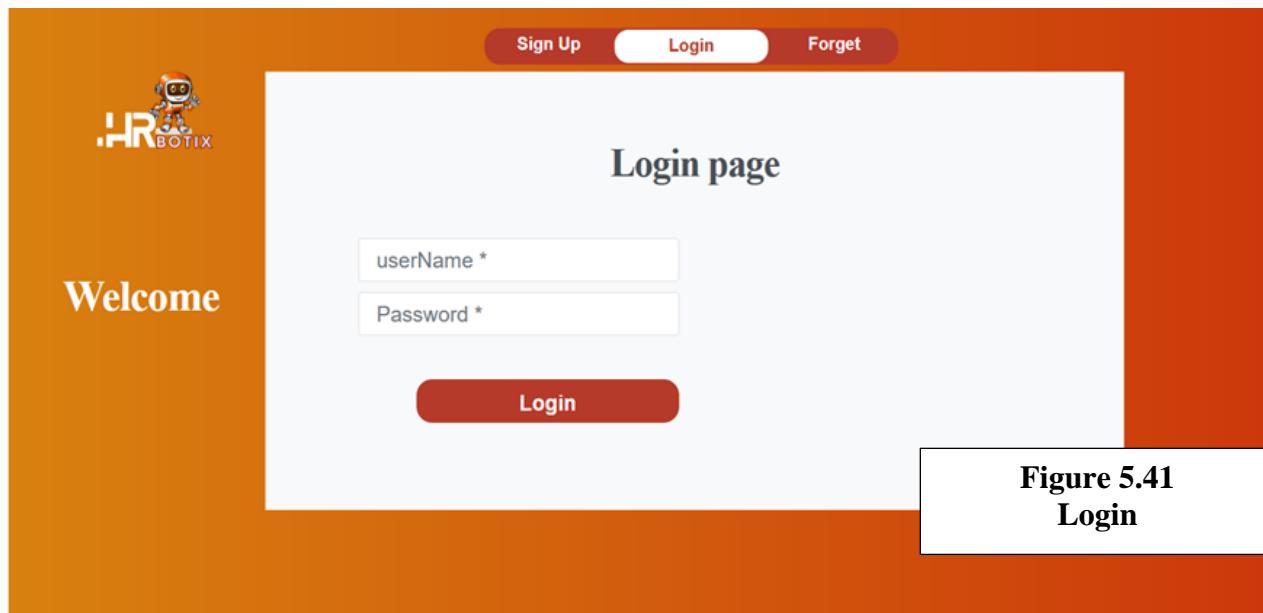
The main page of HRBOTIX offers a comprehensive overview of services and team members. It features a welcoming banner, outlining the platform's HR and job-finding tools. The "Our Services" section highlights key offerings such as CV creation, job search, and chatbot assistance. The "Portfolio" and "About Us" sections showcase the platform's AI-powered HR solutions and company mission. Lastly, the page concludes with a contact form and address details.

# CH.5 Implementation

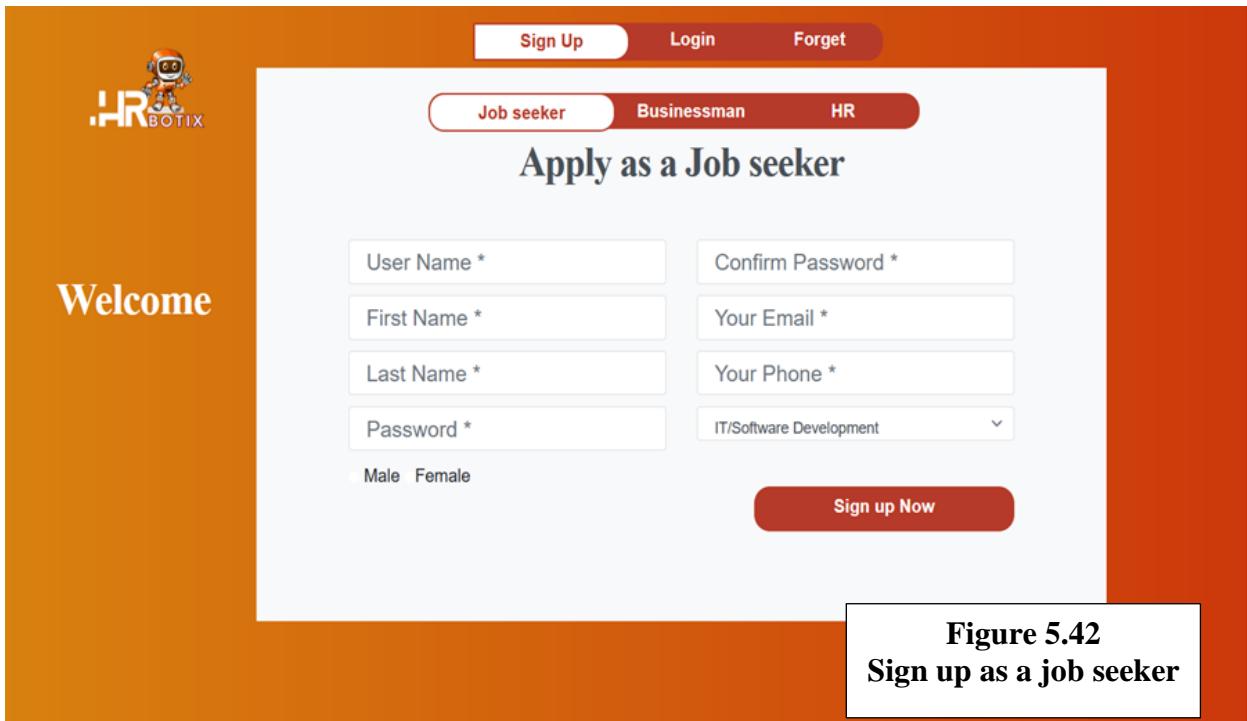


## ● Sign up and Login as a job seeker

This page is for logging in as a person looking for a job, and it receives user data and handles errors if user enters incorrect or unexpected data, this page provides an element of security, as data is encrypted when saved in database, and when we logging in the integrity and correctness of the data is ensured and make sure that the user is a job seeker or not so that his pages are shown to him.



The image shows the 'Login page' of the HR Botix system. The page has an orange header with 'Sign Up', 'Login', and 'Forget' buttons. On the left, there's a 'Welcome' message and the HR Botix logo. The main area contains 'user Name \*' and 'Password \*' input fields, a 'Login' button, and a 'Forgot' link. A callout box on the right is labeled 'Figure 5.41 Login'.



The image shows the 'Apply as a Job seeker' page of the HR Botix system. The page has an orange header with 'Sign Up', 'Login', and 'Forget' buttons. On the left, there's a 'Welcome' message and the HR Botix logo. The main area contains fields for 'User Name \*', 'Confirm Password \*', 'First Name \*', 'Your Email \*', 'Last Name \*', 'Your Phone \*', 'Password \*', and a dropdown for 'IT/Software Development'. There are also 'Male' and 'Female' gender options and a 'Sign up Now' button. A callout box on the right is labeled 'Figure 5.42 Sign up as a job seeker'.

# CH.5 Implementation



The screenshot shows the HRBOTIX sign-up interface for Businessmen. The page has a white header with 'Sign Up', 'Login', and 'Forget' buttons. Below the header, there are three tabs: 'Job seeker' (disabled), 'Businessman' (selected and highlighted in red), and 'HR'. The main section is titled 'Apply as a Businessman' and contains six input fields: 'User Name \*', 'First Name \*', 'Last Name \*', 'Email \*', 'Phone \*', and 'Password \*'. A 'Confirm Password \*' field is also present. A large red 'Sign Up' button is at the bottom right.

Figure 5.43  
Sign up as a  
Businessman

The screenshot shows the HRBOTIX sign-up interface for HR professionals. The layout is identical to Figure 5.43, with a white header, three tabs ('Job seeker', 'Businessman', 'HR'), and a main section titled 'Apply as a HR'. The input fields for 'User Name \*', 'First Name \*', 'Last Name \*', 'Email \*', 'Phone \*', and 'Password \*' are present, along with a 'Confirm Password \*' field. A large red 'Sign Up' button is at the bottom right.

Figure 5.44  
Sign up as a HR

The sign-up section of the HRBOTIX platform offers three distinct roles: Job Seeker, Businessman, and HR. Each role has a dedicated form to fill out, including fields for user details such as username, email, password, first name, last name, phone number, and gender. The Job Seeker role also asks for job specialty, while the Businessman and HR roles include typical contact information and credentials. The forms ensure all required information is provided with validation checks for email, phone number, and password strength. Upon successful sign-up, users can navigate to the appropriate dashboard based on their role.

# CH.5 Implementation



## ○ Home pages

Welcome to HRBOTIX website!

**Hey hossam, happy to help you to**

**Creat CVs**

Create a Attractive CV is a challenge. We are very active in creating and designing CVs and recruiting job seekers

[Find a job](#)

Color Mode

Log Out

**Figure 5.45**  
**Home pages**

Welcome to HRBOTIX website!

**Hey hossam, happy to help you to**

**Make a CV Review**

Create a Attractive CV is a challenge. We are very active in creating and designing CVs and recruiting job seekers

[Find a job](#)

Color Mode

Log Out

**Figure 5.46**  
**Home pages**

# CH.5 Implementation



## ● Home pages

Welcome to HRBOTIX website!

**Hey hossam, happy to help you to**

Create a Attractive CV is a challenge. We are very active in creating and designing CVs and recruiting job seekers

[Find a employee](#)

Home add Job Find a employee Color Mode Log Out

**Figure 5.47**  
**Home pages**

Welcome to HRBOTIX website!

**Hey hossam, happy to help you to**

**Creat CVs**

Create a Attractive CV is a challenge. We are very active in creating and designing CVs and recruiting job seekers

[Find a job seekers](#)

Home Match cv Create CV job seekers search Color Mode Log Out

**Figure 5.48**  
**Home pages**

# CH.5 Implementation



## ● Home pages

The "Home" component for each user type in the code snippet has distinct functionalities tailored to specific roles:

- 1. General User:** The user can navigate the site to find jobs, create CVs, and schedule meetings. The theme can be toggled between light and dark modes, and a chatbot provides assistance.
- 2. Businessman:** This version focuses on adding job listings and searching for employees, offering a streamlined experience for employers to manage job posts and find potential candidates.
- 3. HR (Human Resources):** HR users can match CVs, create CVs, and search for job seekers. The interface supports CV management and job seeker searches, tailored for HR professionals managing recruitment processes.

Each interface shares common elements like the theme toggle, welcome message personalized with the user's name, and a navigation bar for respective functionalities.

# CH.5 Implementation



## • Job seeker pages

### The chatbot

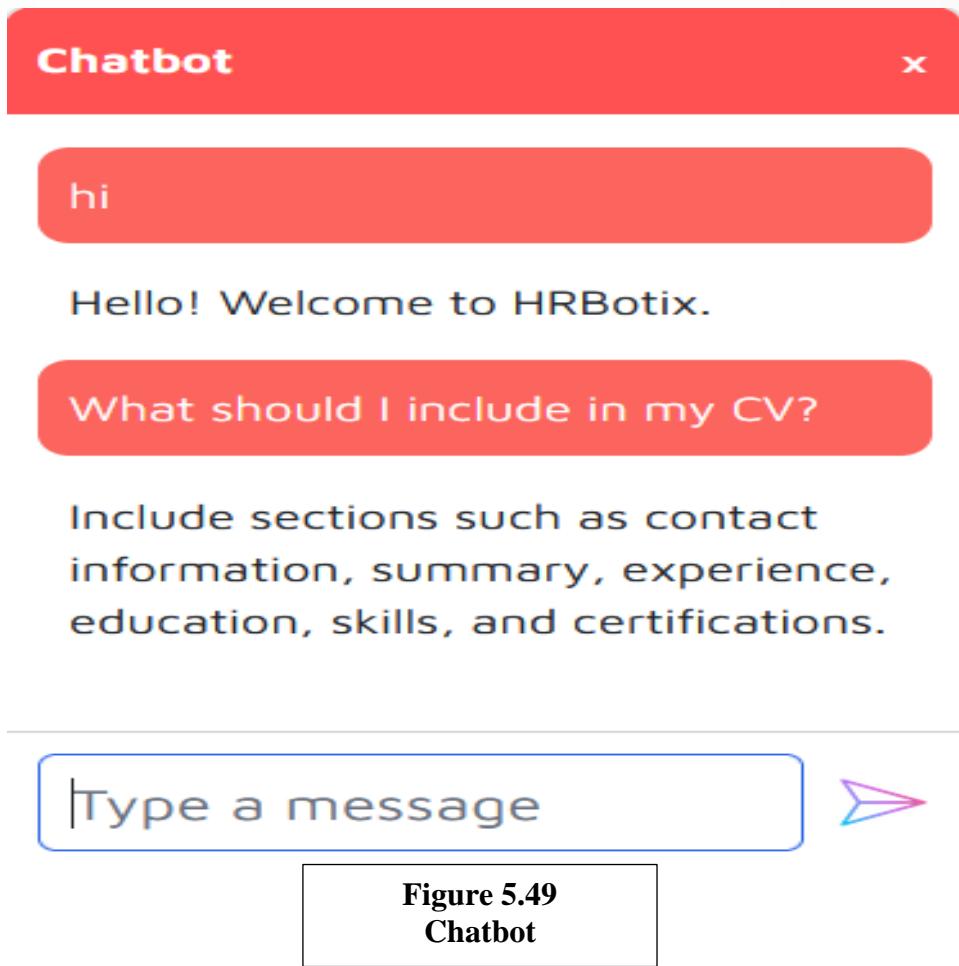


Figure 5.49  
Chatbot

A special model for responding to user questions and inquiries about making and improving a cv and how to respond well in job interviews.

# CH.5 Implementation



## • Job seeker pages

### Find Job

Hi User! Home Find Job Create CV CV Review Meeting scheduling Color Mode Log Out

#### Software Engineer

Company: Company A  
Posted by: John  
Email: johndeo@gmail.com  
Job Type: Full Time  
Posted on: 5/21/2024

Hi User! Home Find Job Create CV CV Review Meeting scheduling Color Mode Log Out

#### Partnerships Manager

Company: Jimdo  
Job Type: full-time  
Job Link: <https://jobicy.com/jobs/107554-partnerships-manager-2>  
Posted on: 6/12/2024

#### Site Reliability Engineer

Company: Upwork

**Figure 5.50**  
**Find Job**

The "Search" page is designed to help users find jobs through both local and global search options. Users can input their search queries in the provided search bar, and the results are displayed in real-time. Local search queries the application's database for job listings, while global search expands the search to online sources, offering a wider array of opportunities.

# CH.5 Implementation



## Job seeker pages

### Create CV

Hi User!

Home Find Job **Create CV** CV Review Meeting scheduling

Color Mode Log Out

SELECT A TEMPLATE TO GET STARTED!

Template 1 Template 2 Template 3 Template 4

Template 1 preview: Serena Wilson, Professional Experience, Education, Skills.

Template 2 preview: Karen Turner, Professional Experience, Education, Skills.

Template 3 preview: Karen Turner, Professional Experience, Education, Skills.

Template 4 preview: Karen Turner, Professional Experience, Education, Skills.

hi HR!

Home Match cv **Create CV** job seekers search

Color Mode Log Out

SELECT A TEMPLATE TO GET STARTED!

Template 1 Template 2 Template 3 Template 4

Template 1 preview: Serena Wilson, Professional Experience, Education, Skills.

Template 2 preview: Karen Turner, Professional Experience, Education, Skills.

Template 3 preview: Karen Turner, Professional Experience, Education, Skills.

Template 4 preview: Karen Turner, Professional Experience, Education, Skills.

**Figure 5.51**  
**Create CV**

This page for job seeker and HR provides the service of creating cv by choosing a template and entering data in, part of this data is optional and another part is mandatory , when cv created user can view and download it in his device .

# CH.5 Implementation



## Job seeker pages

### CV Review

The screenshot shows the 'CV Review' section of the HR Botix system. At the top, a navigation bar includes 'Hi User!', 'Home', 'Find Job', 'Create CV', 'CV Review' (which is red), 'Meeting scheduling', 'Color Mode', and 'Log Out'. Below this is a header with the text 'LET YOUR CV STAND OUT FROM THE CROWD!'. Three main features are highlighted in boxes: 'Extract Information' (our tool scans your PDF CV and extracts key information such as contact details, education, and work experience), 'Recommend Jobs' (based on the extracted information, get job recommendations that match your profile and skills), and 'Detect CV Category' (identify the category of your CV, whether it's for a technical role, managerial position, or other fields). Below these is a 'Browse' button and a file input field containing 'robert cv.pdf'. The main content area shows a sample analysis for a user named 'NAME ROBERT'. It includes a 'Recommended Job: Backend Developer' box, the user's email ('Email: robertkamal00@gmail.com'), phone number ('Phone: 01206339677'), predicted category ('Predicted Category: INFORMATION-TECHNOLOGY'), and a list of skills ('Skills: Python, Communication, SQL, Java, JavaScript, HTML, CSS, Web Development, Frontend Development, Sales').

**Figure 5.52**  
**CV Review**

The CV Review page leverages AI to analyze and enhance user CVs. It extracts key information such as contact details, education, work experience, and skills from PDF CVs. The tool recommends job opportunities tailored to the user's profile and categorizes the CV for appropriate roles, be it technical or managerial. Users can upload their CVs, and the AI provides a comprehensive evaluation to ensure their CV stands out and matches job opportunities effectively.

# CH.5 Implementation



## Job seeker pages

### Meeting scheduling

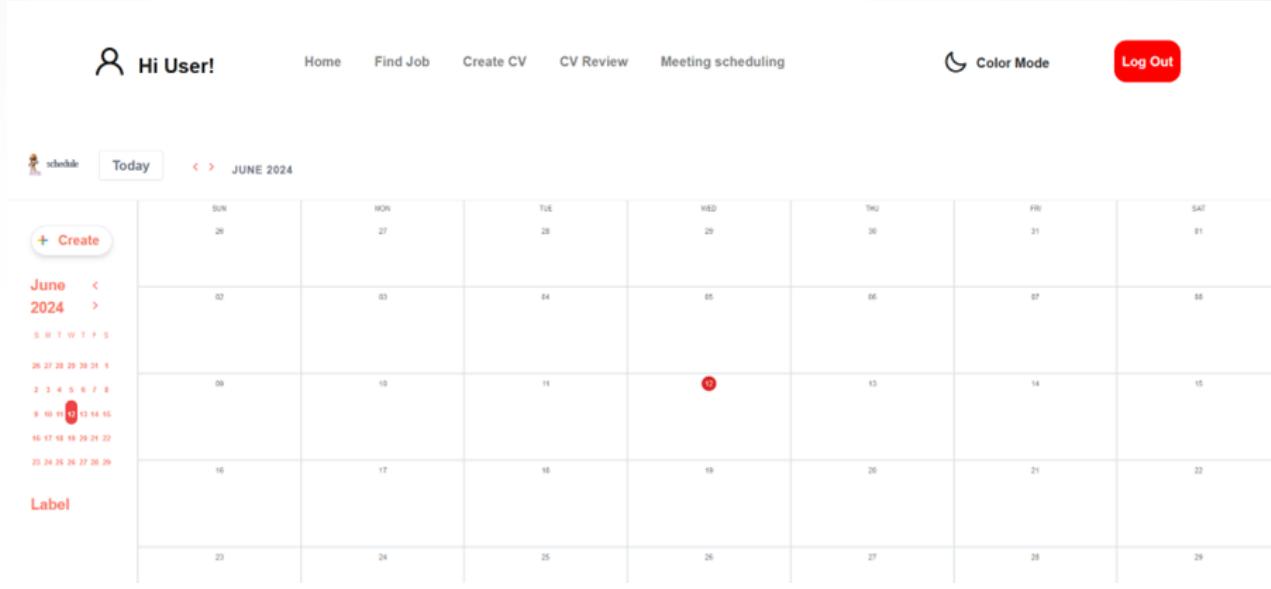


Figure 5.53  
Meeting scheduling

This page for scheduling appointments, organizing and managing time, through the productivity of user increase.

# CH.5 Implementation



## ○ Businessman pages

### Add Job

Job Title\*

Company Name\*

Email\*

Job Type

Skill\*

Delete

Add Skill

search for candidate

**Figure 5.54**  
**Add Job**

The "Add Job" page allows business users to input job details for posting. A businessman can fill out fields such as Job Title, Company Name, Email, Job Type, and required Skills. There is an option to add multiple skills using the "Add Skill" button. Once the form is completed, users can click the "search for candidate" button to save the job listing, making it available in the local search feature for potential candidates.

# CH.5 Implementation



## ○ Businessman pages

### Search for businessman

Hi Businessman!

Home add Job Find a employee: [Color Mode](#) [Log Out](#)

Search by speciality

HOSSAM SAYED  
HOSSAMSAYED@GMAIL.COM  
Information Systems Engineering

HOSSAM SAYED  
HOSSAMMM12505@GMAIL.COM  
Computer Science

HOSSAM SAYED  
GTASYUGDSYAG@GMAIL.COM  
Game design

ABOUT US: HRMS empowers businesses with AI, streamlining HR processes for efficient management. Elevate success with advanced tools, from recruitment to performance management.

ADDRESS: Assuit&Sehag, Egypt  
+201033239589  
hrbotix@gmail.com

CONTACT US: Email:   
Message:   
[Send](#)

Figure 5.55  
Search for  
businessman

### Search for HR

hi HR!

Home Match cv Create CV [job seekers search](#) [Color Mode](#) [Log Out](#)

Search by speciality

HOSSAM SAYED  
HOSSAMSAYED@GMAIL.COM  
Information Systems Engineering

HOSSAM SAYED  
HOSSAMMM12505@GMAIL.COM  
Computer Science

HOSSAM SAYED  
GTASYUGDSYAG@GMAIL.COM  
Game design

ABOUT US: HRMS empowers businesses with AI, streamlining HR processes for efficient management. Elevate success with advanced tools, from recruitment to performance management.

ADDRESS: Assuit&Sehag, Egypt  
+201033239589

CONTACT US: [Goodbye](#)

Figure 5.56  
Search for HR

# CH.5 Implementation



## ○ Businessman pages

The signup page that specifically designed for job seekers to create their profiles. Users are required to enter details such as username, first name, last name, password, email, phone number, and select their job specialty from a dropdown menu. Once the job seekers fill out the form and sign up, their information becomes accessible on the businessman and HR page. This subsequent page allows business professionals and HR personnel to search for and view potential candidates based on their specialties. The purpose of this design is to streamline the recruitment process by providing a dedicated platform for job seekers to showcase their credentials and for employers to easily find qualified candidates.

# CH.5 Implementation



## o HR pages

### Match CV for Job Description

LET YOUR CV STAND OUT FROM THE CROWD!

- Upload CV**  
Upload your CV in PDF format to start the matching process.
- Enter Job Description**  
Provide the job description text to compare against your CV.
- Matching Ratio**  
Receive a matching ratio that indicates how well your CV fits the job post.
- Detailed Analysis**  
Get a detailed analysis of your improvement.

Browse designer.pdf

add Job Description

As a Graphic Designer, you will be responsible for conceptualizing and executing design projects from start to finish. You will work closely with clients and the marketing team to understand design needs, deliver creative solutions, and ensure consistency in brand messaging across all platforms. Your proficiency in Adobe Creative Suite, strong understanding of typography, layout, and color theory, and excellent attention to detail will be essential in creating visually appealing graphics for various marketing materials, including brochures, flyers, and social media posts.

Upload File

PROFILE MATCHING

77.19%

**Figure 5.57**  
**HR- Matching**

The CV Match page allows HR professionals to upload a candidate's CV in PDF format and input a detailed job description. The AI-powered tool then analyzes the provided information to determine how well the CV matches the job requirements. It generates a matching ratio indicating the fit between the candidate and the job. Additionally, a detailed analysis report is provided to highlight areas of strength and improvement in the CV relative to the job description.

# CH.5 Implementation



## 5.10 Summary

This chapter PDF file focuses on the implementation phase of various AI tools and services. It discusses the creation of a CV review page that utilizes AI to analyze and enhance user CVs by extracting key information and recommending tailored job opportunities. Additionally, the main page of HRBOTIX is highlighted, offering a comprehensive overview of services, team members, and key offerings such as CV creation, job search, and chatbot assistance.

Furthermore, the chapter delves into the development of a chatbot model tailored for responding to user inquiries about creating and improving CVs, as well as excelling in job interviews. It also touches upon the sign-up process for HR professionals, showcasing home pages that provide insights into the platform's AI-powered HR solutions and company mission, emphasizing the importance of user-friendly interfaces and comprehensive services.





## 6.1 Summary of the Project

The AI-Enhanced Human Resource Management System, HRBotix, is a comprehensive project that aims to revolutionize HR processes through the integration of advanced technologies like AI, NLP, and ML. The project addresses challenges in traditional HR systems by enhancing model adaptability, fostering data enrichment, and implementing user-friendly interfaces.

By leveraging AI-powered tools, HRBotix streamlines processes, reduces manual errors, and enables data-driven decision-making in HR departments. The project explores key functions of AI in HRM, such as resume parsing, candidate screening, and employee sentiment analysis, offering significant advantages in proactive issue identification and strategic workforce management.

Through a detailed literature review, the project establishes a theoretical framework, identifies gaps in existing research, and outlines the significance, objectives, research questions, and scope of the study.

The analysis and design chapters delve into system development, data gathering, system models, functional requirements, and propose a solution for AI-enhanced HR management. The system design phase focuses on creating intuitive user interfaces and detailing system architecture to meet identified requirements.

The implementation phase highlights the integration of AI tools and services, including CV review, chatbot assistance, and job search functionalities, emphasizing user-friendly interfaces and comprehensive HR solutions.

### **Scope of the Proposed System (HRBotix):**

1. HRBotix aims to enhance HR processes through AI-driven technologies like NLP and ML.
2. The system focuses on streamlining candidate screening, resume parsing, and employee sentiment analysis.
3. HRBotix facilitates data enrichment, dynamic model training, and transfer learning for seamless candidate-job matching.
4. The system empowers companies in performance analysis by aligning candidate skills with job requirements.
5. HRBotix offers user-friendly interfaces for HR professionals, enabling efficient data-driven decision-making.
6. The scope of HRBotix extends to addressing challenges in traditional HR systems, bridging gaps in existing research, and advancing HR practices through AI technology.

## 6.2 Challenging

One of the main challenges encountered during the development and implementation of the AI-Enhanced Human Resource Management System (AI-EHRMS) was the integration of advanced AI technologies like NLP and ML into the existing HR processes. This required collecting and organizing a large amount of data related to candidate resumes, job requirements, and employee sentiment analysis. The system had to adapt to different data formats and sources to ensure seamless integration and accurate results.

Another challenge was the need to develop AI models that could effectively address biases in the recruitment process and ensure inclusivity in candidate selection. Machine learning algorithms had to be trained to recognize and mitigate potential biases in resume screening and job matching, enhancing the fairness and effectiveness of the system.

The final challenge was designing a user-friendly interface for the AI-EHRMS that would be intuitive for HR professionals to use. The interface needed to provide easy access to AI-powered tools for tasks like resume parsing, candidate screening, and employee sentiment analysis. Ensuring that the interface was user-friendly and efficient in facilitating data-driven decision-making in HR processes was crucial for the successful adoption of the system.

Overall, overcoming these challenges in developing and implementing the AI-Enhanced Human Resource Management System was a complex yet rewarding endeavor. The project team successfully navigated the complexities of integrating AI technologies into HR processes, addressing biases, and designing a user-friendly interface to create a valuable and efficient system for HR management.

## 6.3 Contributions and Implications

The AI-Enhanced Human Resource Management System (AI-EHRMS) offers significant contributions and implications for the field of HR management and technology integration.

- 1) *Enhanced Efficiency and Accuracy:* AI-EHRMS automates HR tasks, improves recruitment efficiency, and ensures accurate candidate-job fit.
- 2) *Data-Driven Decision-Making:* AI-EHRMS enables HR professionals to make informed decisions based on objective data and insights from candidate profiles and employee sentiment analysis.

# Conclusion



CH.6

- 3) *Bias Mitigation and Inclusivity:* AI-EHRMS addresses biases in the recruitment process, promoting fair and inclusive candidate selection.
- 4) *Personalized Candidate Experience:* AI-EHRMS offers tailored job recommendations based on individual skills and preferences, enhancing candidate engagement and satisfaction.
- 5) *Strategic HR Planning:* AI-EHRMS provides performance analytics, trend analysis, and predictive insights for proactive HR planning and talent acquisition strategies.
- 6) *Future Trends and Innovation:* AI-EHRMS drives advancements in AI-HRM integration, shaping the future of HR management practices and paving the way for continuous evolution.

## 6.4 Limitations

Despite the many strengths of AI-EHRMS, we also faced some limitations during implementation, but we tried to overcome them, and we largely succeeded. Our success was achieved in completing the project.

1. *Data Scarcity and Quality:* AI-EHRMS effectiveness depends on the availability and quality of data, which may lead to biased results or inaccurate recommendations with limited or incomplete datasets.
2. *Implementation Challenges:* Integrating AI technologies in HR processes can be complex and resource-intensive, impacting scalability, usability, and performance of AI-EHRMS.
3. *Ethical Considerations:* AI-EHRMS must adhere to ethical guidelines and regulations regarding data privacy, fairness, and transparency to maintain trust and avoid legal implications.
4. *User Adoption and Training:* HR professionals may require training to effectively use AI-EHRMS, and resistance to change or lack of training resources can hinder successful implementation.
5. *System Maintenance and Updates:* Regular maintenance, updates, and monitoring are necessary to ensure optimal performance and relevance of AI-EHRMS over time.



## 6.5 Future Work

The AI-EHRM system to recommend the final project has several potential implications for future research and development.

- 1- *Applicant Tracking and Ranking:* Future work could focus on enhancing AI algorithms for more accurate applicant tracking and ranking in HR processes.
- 2- *Training and Development Programs:* Further development is needed to create personalized and effective training and development programs using AI technologies.
- 3- *Performance Management:* Future efforts should aim to optimize AI-driven performance management systems for better employee evaluation and feedback.
- 4- *Employee Sentiment Analysis:* Enhancements in AI-based sentiment analysis tools can provide deeper insights into employee morale and engagement.
- 5- *Workforce Analytics and Planning:* Future work may involve refining AI algorithms for more precise workforce analytics and strategic planning in HR management.

# Message of thanks



## Thank You for Being a Part of Our Journey! 🎓🌟

This project represents not just the end of a chapter, but the beginning of new adventures. It's a testament to our dedication, teamwork, and passion for creating beautiful, functional web experiences.

We are grateful for the guidance and support we've received along the way. As we move forward, we carry with us the lessons learned and the memories made.

*With gratitude, The Dev Team*

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