UNIVERSITY OF BUEA

COLLEGE OF TECHNOLOGY

DEPARTMENT OF COMPUTER ENGINEERING

EMPLOYEE PERFORMANCE PREDICTION SYSTEM

By

BOFUANG PAVEL GEWAI

CT22A043

Supervisor:

DR. TCHAGNA AURELLE

MR.BALOKO

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CERTIFICATION

I hereby certify that this project report entitled "**EMPLOYEE PERFORMANCE PREDICTION SYSTEM**" has been carried out by **BOFUANG PAVEL GEWAI** with matriculation number **CT22A043** and submitted to the Department of Computer Engineering of the College of Technology of the University of Buea in partial fulfillment of the requirements for the award of the degree of Bachelors in Technology in Computer Engineering.

Head of Department:

Signature: _____

PROF. MOFFO **Date**: _____

Supervisors:

Signature:  **Date:** June 09, 2025

DR.
TCHAGNA
AURELLE

Signature: _____

MR. BALOKO **Date:** _____

ATTESTATION

This is to testify that I am the authors of this project report entitled "**EMPLOYEE PERFORMANCE PREDICTION SYSTEM**". I give permission to the College of Technology of the University of Buea through our department to lend this project report to other institutions or individuals for the purpose of scholarly research. I understand the nature of plagiarism and I am aware of the university's policy on this.

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Signature: _____ Date: _____

BOFUANG PAVEL GEWAI
CT22A043

DEDICATION

To the BOFUANG'S family.

ACKNOWLEDGMENT

I would like to extend my sincere gratitude to all those who have supported and contributed to the successful completion of this project.

I am especially grateful to my academic supervisor**,** DR. Tchagna Aurelle and MR.Baloko, whose mentorship and unwavering support have been incredibly valuable. His insightful feedback, patience, and encouragement played a key role in shaping the direction and quality of this work.

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A heartfelt thank you goes to my family, whose love, motivation, and continuous support have been a strong pillar behind my academic achievements. Their belief in me, even in difficult times, has pushed me to stay focused and persevere.

Finally, to everyone who, in one way or another, contributed to my academic and personal development, please accept my deepest thanks. Your encouragement and support have left a lasting impact, and I am truly appreciative of all you've done.

ABSTRACT

The project presented in this document focuses on the design and implementation of an Employee Performance Prediction System, aimed at helping organizations evaluate employee performance in a more objective and efficient manner. Traditional performance evaluation methods are often manual, biased, and time-consuming, resulting in poor decision-making and decreased productivity. This system addresses these challenges by using machine learning techniques to predict employee performance levels (High, Medium, Low) based on quantifiable data such as hours worked, attendance, project completion, and feedback. The system was developed using a combination of modern technologies: the backend was built with FastAPI, and the frontend was developed using React and CSS for a responsive user interface. The ML pipeline was constructed using Python libraries such as Scikit-learn, Pandas, and NumPy, with Joblib for model serialization. The project followed a structured methodology including data collection, preprocessing, model training, evaluation, and deployment. Diagrams were modeled to illustrate system behavior and design, including use case, class, and activity diagrams. The resulting system allows HR managers to input employee data, receive real-time predictions, and make informed decisions regarding promotions, training, or performance improvements. This application stands to improve fairness, efficiency, and transparency in employee evaluations within organizations.

Keywords: Employee performance, Machine learning, Prediction system, HR management, Evaluation automation

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API	Application Programming Interface
API (in REST)	Application Programming Interface (used in RESTful APIs)
CORS	Cross-Origin Resource Sharing
ERD	Entity Relationship Diagram
FCFA	Franc de la Communauté Financière Africaine
Figma	UI/UX Design Tool
HR	Human Resources
HTTP	Hyper Text Transfer Protocol
HTTP POST	Hypertext Transfer Protocol Post Method
IDE	Integrated Development Environment
iOS	iPhone Operating System
Joblib	Python Library for Model Serialization
JSON	JavaScript Object Notation
macOS	Mac Operating System
ML	Machine Learning
MoMo	Mobile Money
MTN	Mobile Telephone Network
NoSQL	No Structured Query Language
NumPy	Numerical Python
Pandas	Python Data Analysis Library
Scikit-learn	Machine Learning Library for Python
SDLC	Software Development Life Cycle
SQLite	Structured Query Language Lite
UI	User Interface
UML	Unified Modeling Language
UX	User Experience
VS Code	Visual Studio Code

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CHAPTER I

GENERAL INTRODUCTION

1.1 Introduction

In today's competitive organizational environment, employee performance plays a crucial role in determining the success and growth of companies. Organizations rely on performance evaluations to make decisions regarding promotions, rewards, training, and even terminations. Traditionally, these evaluations are conducted manually and often depend on the subjective judgment of managers, which introduces bias and inconsistency. With the rise of data science and artificial intelligence, there is an opportunity to make performance evaluation more objective, fair, and data-driven.

This project introduces an Employee Performance Prediction System that uses machine learning to predict employee performance levels (High, Medium, or Low) based on measurable metrics such as working hours, attendance, project completion rates, and feedback. This system not only reduces the workload of Human Resource (HR) departments but also ensures transparency and fairness in evaluating employee performance.

1.2 Background and Context of the Study

In most organizations, performance reviews are conducted manually using checklists or verbal feedback from supervisors. These methods often result in biased assessments, favoritism, and poor decision-making, ultimately leading to decreased employee motivation and productivity. Having worked in different collaborative environments and observed how performance assessments are inconsistently applied, I recognized the need for a system that can predict performance using objective data.

By integrating machine learning models into HR management systems, companies can shift from opinion-based decisions to data-backed insights. This project was inspired by the growing importance of artificial intelligence in human resources and the need to automate repetitive HR tasks while maintaining data accuracy and decision integrity.

1.3 Statement of the Problem

Organizations often lack a standardized, objective method for evaluating employee performance. The existing systems depend heavily on human judgment, which can lead to:

- Bias in performance ratings
- Lack of transparency
- Delayed decisions on promotions or terminations
- Poor identification of underperforming or high-performing employees

These issues can reduce productivity and morale. Therefore, there is a pressing need to develop a system that can automatically predict employee performance using quantifiable data.

1.4 Objectives of the Study

1.4.1 General Objective

To develop a data-driven Employee Performance Prediction System using machine learning algorithms or techniques that aids HR managers in making objective and accurate decisions.

1.4.2 Specific Objectives

1. To collect and preprocess relevant employee data such as hours worked, project completion, and attendance.
2. To train and evaluate machine learning models to classify employees as High, Medium, or Low performers.
3. To develop a responsive frontend interface that allows HR managers to input employee data and view predictions.
4. To integrate the model with a backend API for real-time predictions.
5. To ensure data privacy, scalability, and system reliability during deployment.

1.5 Significance of the Study

The primary stakeholders for this project are HR departments and organizational leadership. The developed system will:

- Eliminate subjectivity from employee performance assessments
- Reduce administrative workload
- Help organizations identify talent and underperformance early
- Improve transparency and fairness in HR decisions
- Enable better planning for training, promotions, or restructuring

Ultimately, this system enhances organizational efficiency and boosts employee morale through accurate, unbiased evaluations.

1.6 Scope of the Study

This study is focused on designing and implementing a machine learning–based web application for employee performance prediction. The system allows HR professionals to enter employee data and receive performance predictions instantly. It consists of a frontend developed in React, a backend powered by FastAPI, and a machine learning model built with Scikit-learn**,** Pandas, and NumPy**.**

Geographical Scope:

The system was developed and tested using simulated datasets and applies to organizational settings that manage employee performance.

1.7 Definition of Key Terms

- **Employee Performance**: A measure of how well an employee fulfills their job responsibilities and contributes to organizational goals.
- **Machine Learning**: A subset of AI that uses data to train models and make predictions without explicit programming.
- **FastAPI**: A modern Python web framework used to build APIs quickly and efficiently.
- **React**: A frontend JavaScript library used for building responsive and interactive user interfaces.
- **Prediction System**: A software tool that uses algorithms to forecast future outcomes based on input data.

1.8 Project Report Overview

This project report is structured as follows:

- **Chapter One** introduces the background, problem statement, objectives, significance, and scope of the study.
- **Chapter Two** presents a review of existing systems, related literature, and a proposed solution to improve upon them.
- **Chapter Three** discusses the materials and methodology used, including functional and non-functional requirements, design diagrams (use case, sequence, class, and ERD), and the cost estimation.
- **Chapter Four** covers the implementation phase, system testing, and results obtained.
- **Chapter Five** provides the conclusion, project limitations, and recommendations for future improvements.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter presents a detailed literature review of existing systems related to employee performance prediction and evaluation. The purpose of this review is to identify and analyze key systems and research studies that have tackled similar challenges. By understanding the strengths and limitations of current solutions, this review provides valuable insights that guided the design and implementation of the Employee Performance Prediction System proposed in this project.

2.2 Review of Existing Systems

In this section, we examine five existing systems and studies that focus on employee performance tracking and prediction using data-driven or automated methods. Each system is reviewed based on its core functionality, advantages, and limitations.

1. Zoho People

Zoho People is an online HR software that helps organizations manage employee data, attendance, and performance reviews. It features customizable appraisal cycles, self-service options, and automation tools, all within a user-friendly interface. It integrates well with other Zoho products for seamless workflow.

However, the platform depends heavily on manual input and subjective reviews from managers. It lacks built-in machine learning or predictive analytics capabilities for data-driven performance evaluation.
Source: Zoho People. (n.d.). HR Software for Small and Medium Businesses. Retrieved from https://www.zoho.com/people/

2. Keka HR

Keka is a cloud-based HR solution that supports continuous performance tracking, feedback collection, and OKR-based evaluations. It features a modern design, integration with payroll and attendance systems, and tools to improve employee engagement and performance visibility.

Despite its robust goal-tracking functions, Keka does not yet offer machine learning features for predictive analysis. Its evaluation process remains mostly descriptive rather than analytical.
Source: Keka. (n.d.). Performance Management Software. Retrieved from https://www.keka.com/performance-management-software

3. PeopleGoal

PeopleGoal is a performance management platform that enables organizations to manage goals and feedback using an OKR-based approach. It supports integrations with platforms like Microsoft Teams, Slack, and various HRIS systems to streamline engagement and communication.

While effective for goal tracking in larger enterprises, the software lacks machine learning tools for performance prediction, making it less useful for data-driven HR strategies.
Source: PeopleGoal. (n.d.). OKRs and Performance Management Platform. Retrieved from https://www.peoplegoal.com/

4. Synergita

Synergita offers a continuous performance management solution that emphasizes 360-degree feedback, goal setting, and skill assessment. It supports multiple review methods and provides basic employee engagement analytics for HR teams.

However, its capabilities in predictive modeling and machine learning are limited. The platform is more focused on enhancing qualitative feedback than applying advanced analytics.
Source: Synergita. (n.d.). Performance Management Software. Retrieved from https://www.synergita.com/

5. ML-based Research Studies

Several academic studies have demonstrated how supervised learning models such as Decision Trees, Random Forests, and SVM can be used to predict employee performance based on features like task completion, attendance, and feedback scores. These models aim to reduce bias and enhance objectivity in employee evaluations.

Although promising, most studies rely on limited or synthetic data and are rarely implemented in real-world HR systems. Full-scale integration into enterprise software remains a challenge.
Sources:
• Joshi, R., & Kaur, P. (2020). Prediction of Employee Performance Using Machine Learning. IJERT.
• Awan, M. J., & Ali, A. (2021). Predictive Analytics of Employee Performance Using Supervised Learning Techniques. Procedia Computer Science, 192, 515–524.

2.3 Review of Related Concepts

To better understand how existing systems compare with the proposed solution, the following table presents a comparison based on three criteria**:** features, functionalities, and level of automation.

Table 2.1: Comparison of similar systems

System	Features	Functionalities	Automation
Proposed System	Predict performance, analyze data, visualize results	Performance prediction, real-time analytics	High
Zoho People	Appraisal tools, HR data management	Self-assessment, reviews	Low
Keka HR	Goal tracking, employee engagement	Continuous feedback, manual appraisal	Medium
PeopleGoal	OKRs, integration tools	Goal alignment, performance reviews	Medium
Synergita	360-degree feedback, appraisal cycle management	Feedback tracking, development planning	Medium
ML Research	Data modeling, predictive classification	Employee performance classification	High (Limited Deployment)

2.4 Proposed System

After analyzing the existing systems and research literature, it is clear that while many solutions provide good performance tracking capabilities, few offer automated, objective, and predictive evaluation features powered by machine learning.

The proposed system Employee Performance Prediction System is specifically designed to fill this gap. This system is built using FastAPI (backend), React (frontend), and Python-based machine learning libraries such as Scikit-learn, Pandas, and NumPy.

Key features of the system include:

- **Data Input**: HR managers can input employee metrics such as hours worked, attendance, project completion, and feedback scores.
- **ML-Based Predictions**: The system processes the data and predicts performance levels (High, Medium, or Low) using a trained classification model.
- **Insights & Analytics**: Visualization tools present performance trends and patterns over time.
- **Integrated Workflow**: The system seamlessly connects frontend inputs to backend processing and displays results in real-time.
- **Bias Reduction**: By using objective data, the system minimizes human bias in performance evaluations.

- **Secure Handling**: Employee data is securely transmitted and stored, ensuring privacy and compliance.

Unlike traditional performance management systems, this application does not just track activities or rely on feedback alone—it uses statistical models to predict outcomes, giving organizations a proactive tool for workforce planning and development.

CHAPTER III

MATERIALS AND METHODS USED

3.1 Introduction

This chapter focuses on the analysis and execution of the software development process for the Employee Performance Prediction System. It explores key aspects such as the development methodology, system analysis, and system design. Through careful planning and execution of these steps, the goal is to ensure that the final system meets the expectations of all stakeholders and delivers a reliable, scalable, and user-friendly performance evaluation solution.

3.2 Development Methodology Used

Agile supports continuous improvement, flexibility, and quick delivery of working components. The system was developed in iterations, each with distinct goals such as data preprocessing, model training, API development, and UI design. This approach allowed regular feedback integration, leading to an optimized, user-centric employee performance prediction platform.

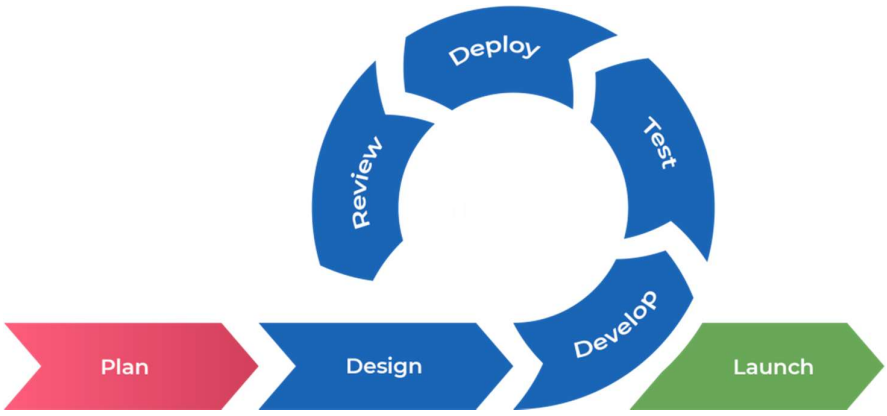

Figure 1: **Agile Methodology**

3.3 Methods Used

3.3.1 System Analysis

a. Functional Requirements

- HR authentication (login/logout)
- Enter employee data (e.g., hours worked, projects completed)

- Predict employee performance level (High, Medium, Low)
- Display prediction results
- View historical prediction data
- Access analytics/dashboard (future scope)

b. Non-Functional Requirements

Category	Details
Operation	Intuitive UI, browser compatibility
Performance	Fast loading, real-time prediction responses, minimal API latency
Security	Secure login, token-based authentication, data encryption
Capacity	Scalable backend capable of handling thousands of prediction requests
Reliability	99.9% uptime, automatic error recovery
Integrity	Validation for input data, error handling for ML model and API responses
Compatibility	Works with modern browsers and integrates well with HR software tools
Ergonomics	Clear visual hierarchy, dashboard aesthetics, accessibility support

c. Use Case Analysis

Use case diagrams illustrate how different users interact with the system. In this case, the HR manager is the primary actor.

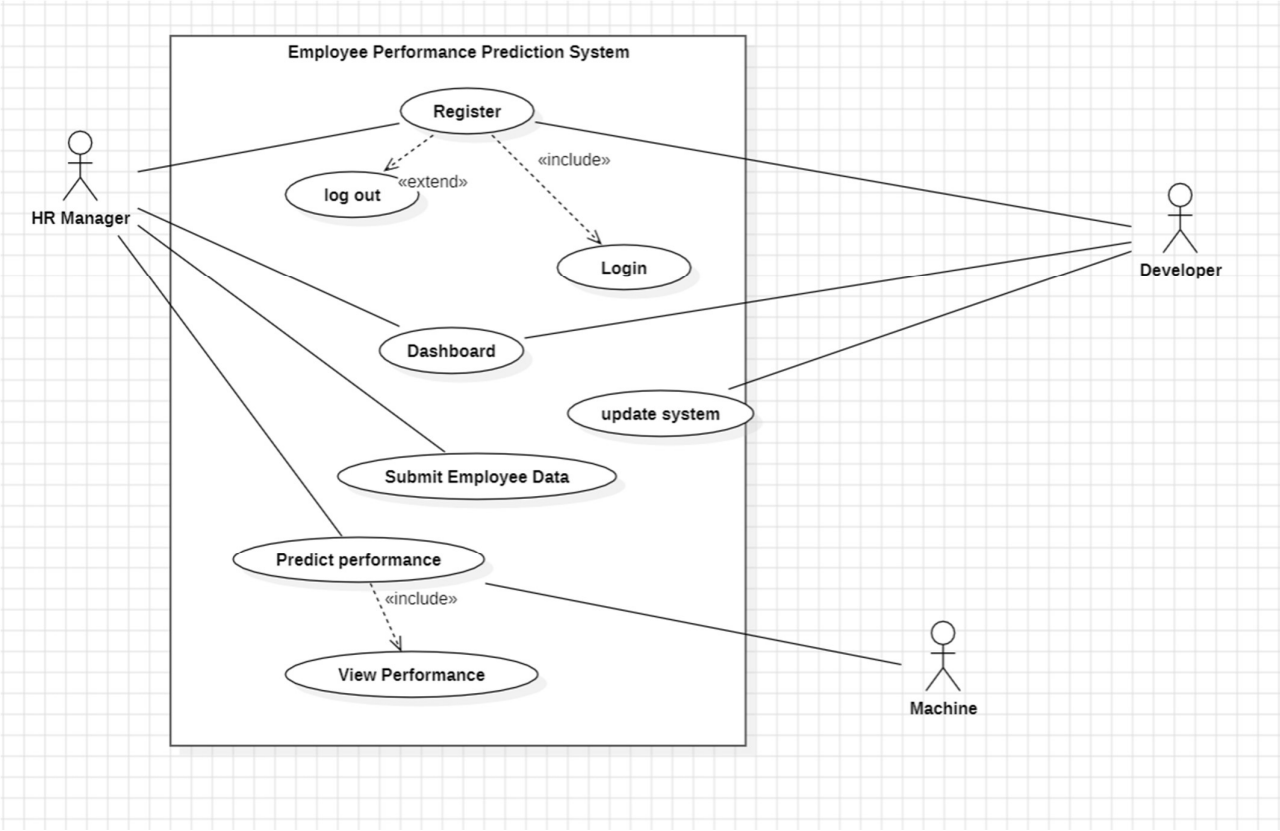

Figure 2: Use Case Diagram

d. Sequence Diagram

The sequence diagram outlines the process flow when an HR manager submits employee data and receives a prediction result.

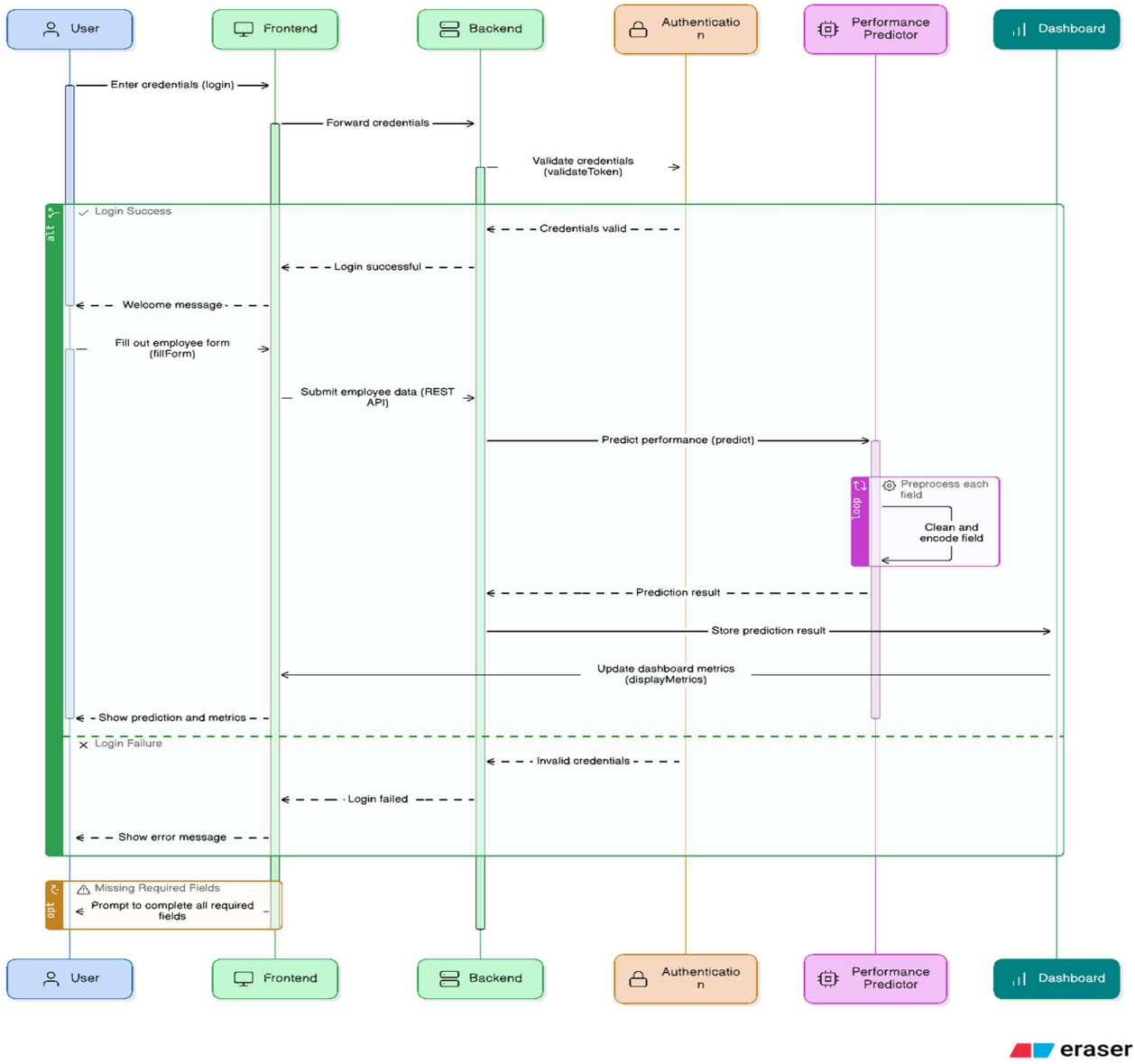

Figure 3: Sequence Diagram

e. Cost Evaluation

Item	Estimated Cost (FCFA)
Frontend Development	200,000
Backend/API Development	200,000
UI/UX Design	50,000
Model Training & Testing	100,000
Deployment/Hosting	20,000
Internet & Infrastructure	30,000
Total Estimated Cost	**600,000**

3.3.2 Tools, Materials and Methodology Used

- **Languages & Frameworks**
  - **React**: Frontend framework for building responsive UIs.
  - **FastAPI**: Python web framework used for backend API logic.
  - **Scikit-learn**: For training the ML model.
  - **Pandas & NumPy**: For data manipulation and preprocessing.
  - **Joblib**: For saving/loading trained models.
- **Database**
  - **SQLite**: Lightweight, easy-to-integrate database used to store employee records and prediction history.
- **Additional Tools**
  - **Lucidchart, StarUml, Eraser**: Used to design UML diagrams (use case, class, and sequence diagrams).
  - **Postman**: Used for testing API endpoints and checking data flow between frontend and backend.
  - **Git & GitHub**: Version control and collaboration.

b. Hardware Requirements

Specification	Minimum Requirement
Processor	Dual-core 2.0 GHz
RAM	4 GB
Disk Space	500 MB (for model + logs)
Device Compatibility	Desktop, Laptop, Tablet

c. Software Requirements

Component	Requirement
OS	Windows/Linux/MacOS
Browser	Chrome, Firefox, Edge
Python Version	Python 3.9+
Node.js	14+
React	v18+

d. System Architecture

The system follows a 3-tier architecture for separation of concerns:

1. **Presentation Layer (React)**: Interface used by HR managers.
2. **Application Layer (FastAPI)**: Handles logic and communication.
3. **Data Layer (Model/Database)**: Stores data and manages predictions.

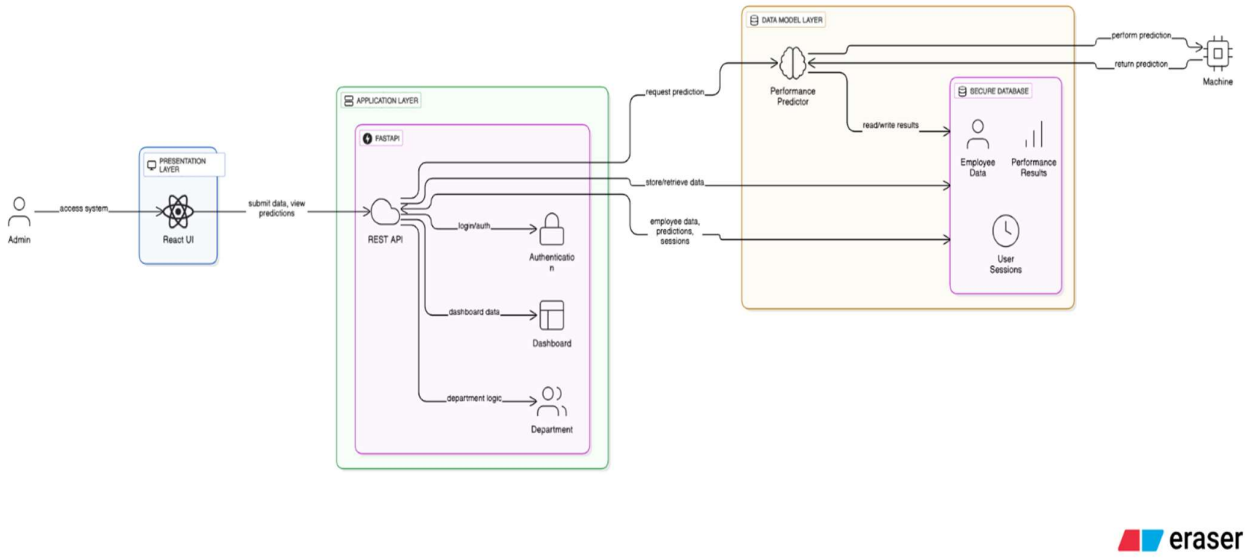

Figure 4: System Architecture Diagram

e. User Interface Design

The frontend interface was carefully crafted with clarity and usability in mind. HR managers can easily navigate through input forms, view predictions, and analyze performance trends. Figma was used to create design prototypes before React implementation.

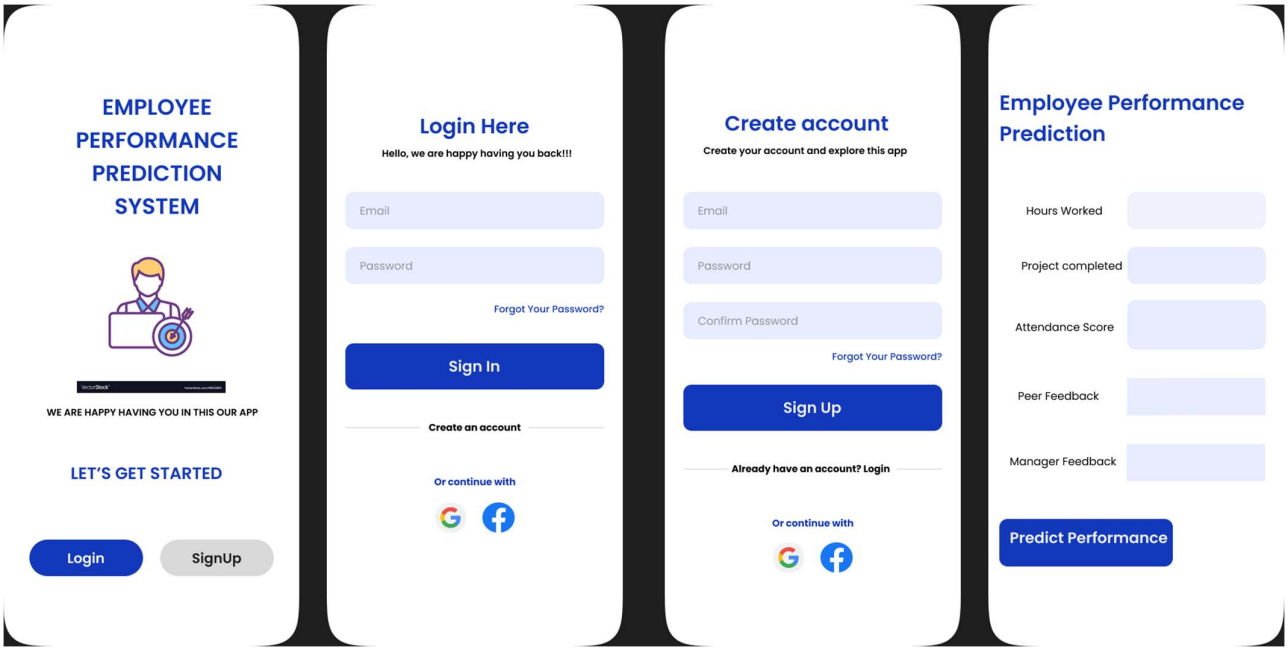

Figure 5: User Interface

f. Class Diagram

The class diagram defines system structure, showing how employee data, predictions, and user sessions relate.

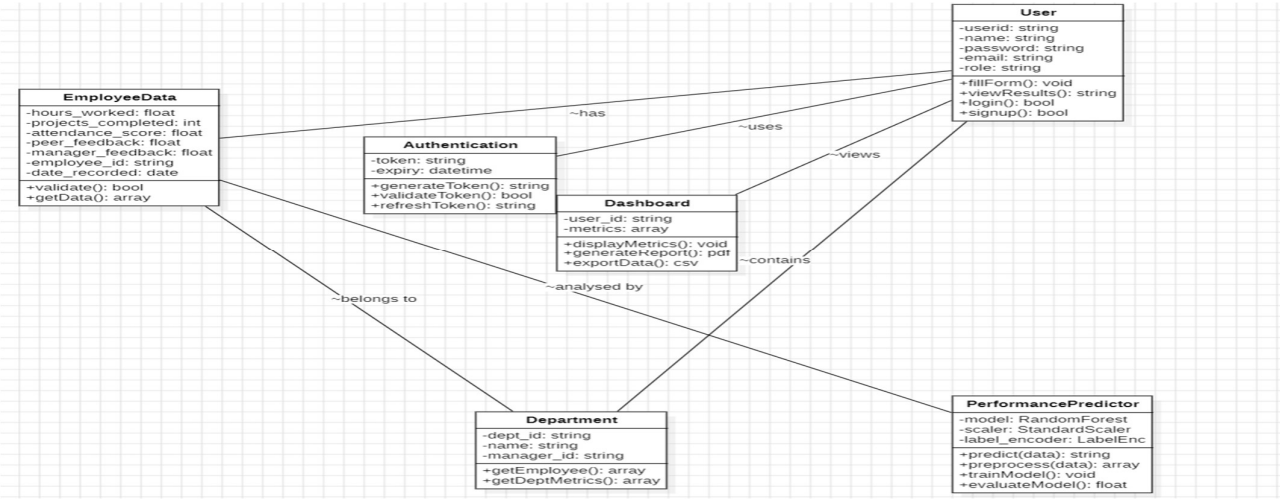

Figure 6: Class Diagram

CHAPTER IV
IMPLEMENTATION AND RESULTS

4.1 Introduction

Following the analysis and design phases, the project transitioned into the implementation stage. UI prototypes were initially created using design tools, followed by the development of both the frontend and backend systems. The backend included a trained machine learning model integrated with a FastAPI service, while the frontend was developed using React. Postman was used extensively for testing RESTful API endpoints before integration with the frontend. After implementation, the system underwent thorough testing to ensure all functionalities met their respective requirements and operated reliably.

4.2 Implementation

The Employee Performance Prediction System was implemented using modern technologies and tools. The architecture was divided into two main parts: the frontend, built with React for user interactions, and the backend, built with FastAPI to handle API logic and machine learning model predictions.

Backend Implementation

The backend is responsible for processing employee input data and returning performance predictions. RESTful endpoints were created for:

- Accepting employee data via HTTP POST
- Processing the data with the trained machine learning model
- Returning prediction results to the frontend

Postman was used to test endpoints before frontend integration.

Frontend Implementation

The frontend was built using React. The application was modularized using reusable components. The UI allows HR managers to:

- Log in
- Enter employee performance data
- Submit data to the backend
- Instantly view predicted performance level (High, Medium, Low)

4.3 Results

The final application included the following functional components, each designed to improve HR operations and deliver accurate performance insights:

i. Authentication Module

HR managers can securely log in to the system to access employee evaluation tools.

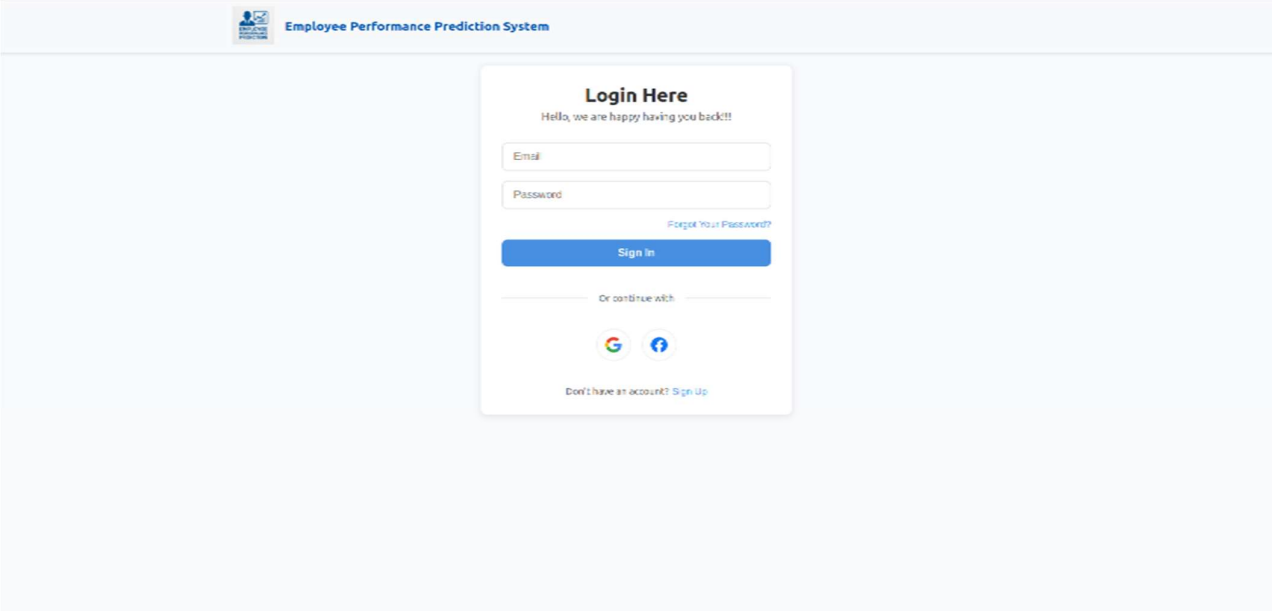

Figure 7: Authentication Screen (Login)

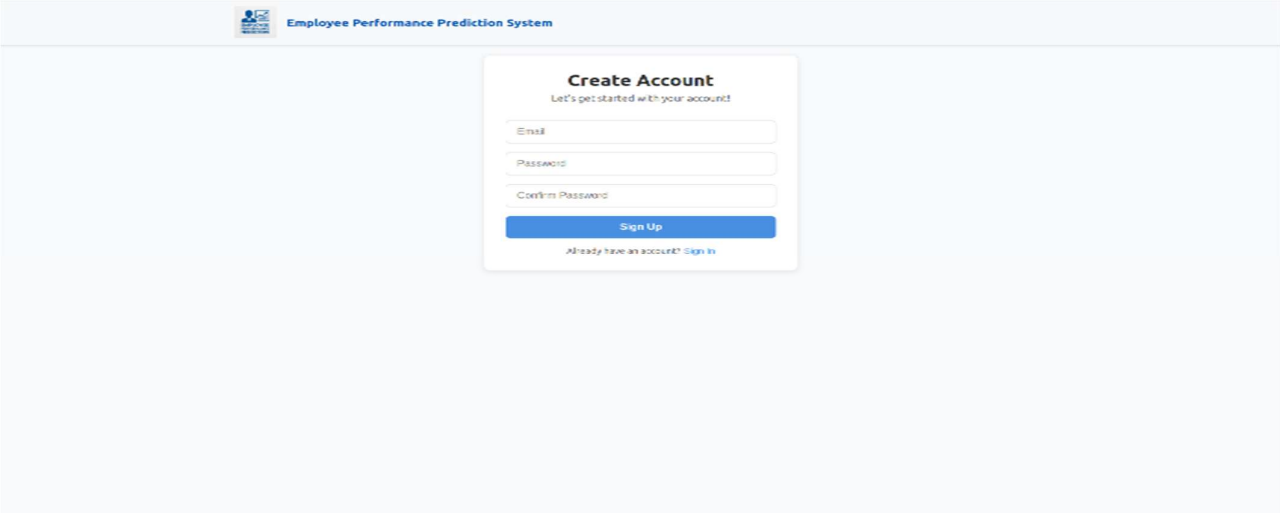

Figure 8: Authentication Screen (Sign Up)

ii. Performance Input Form

This screen enables the entry of employee data such as hours worked, attendance, and project scores.

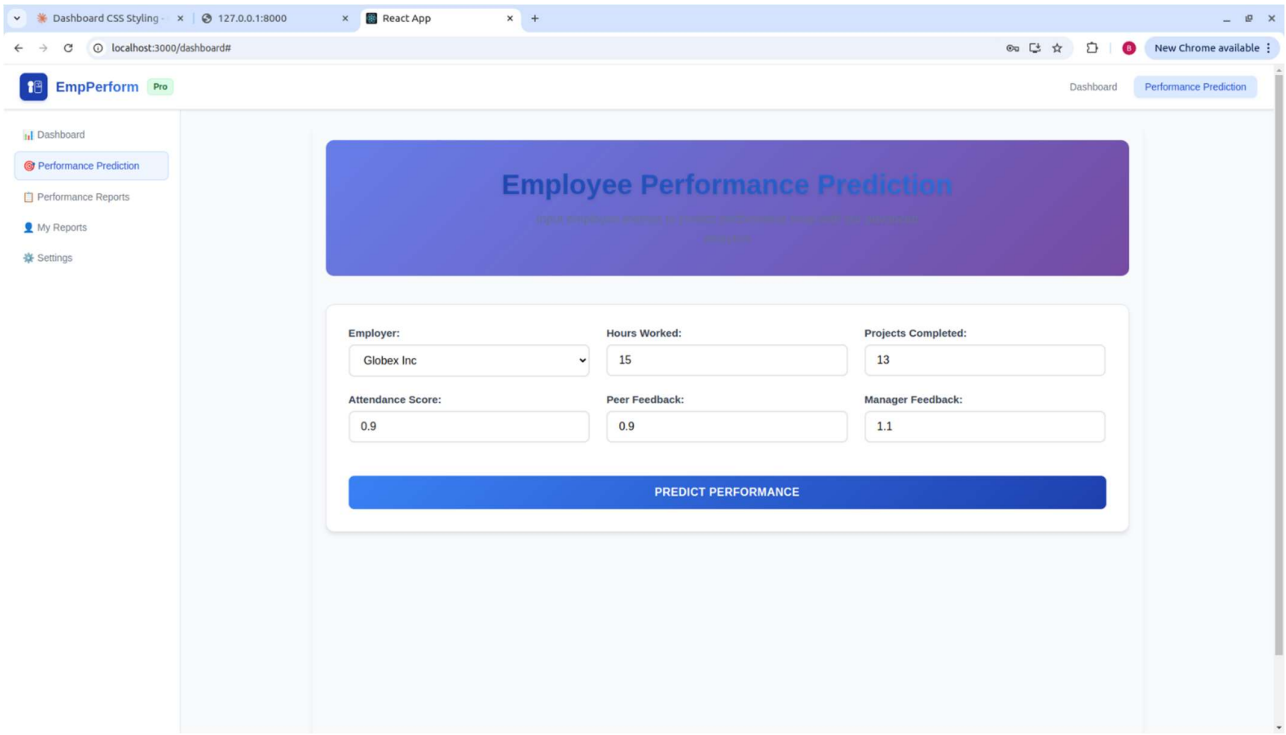

Figure 9: Data Input Interface

iii. **Prediction Output**

Once the data is submitted, the predicted performance level is displayed immediately.

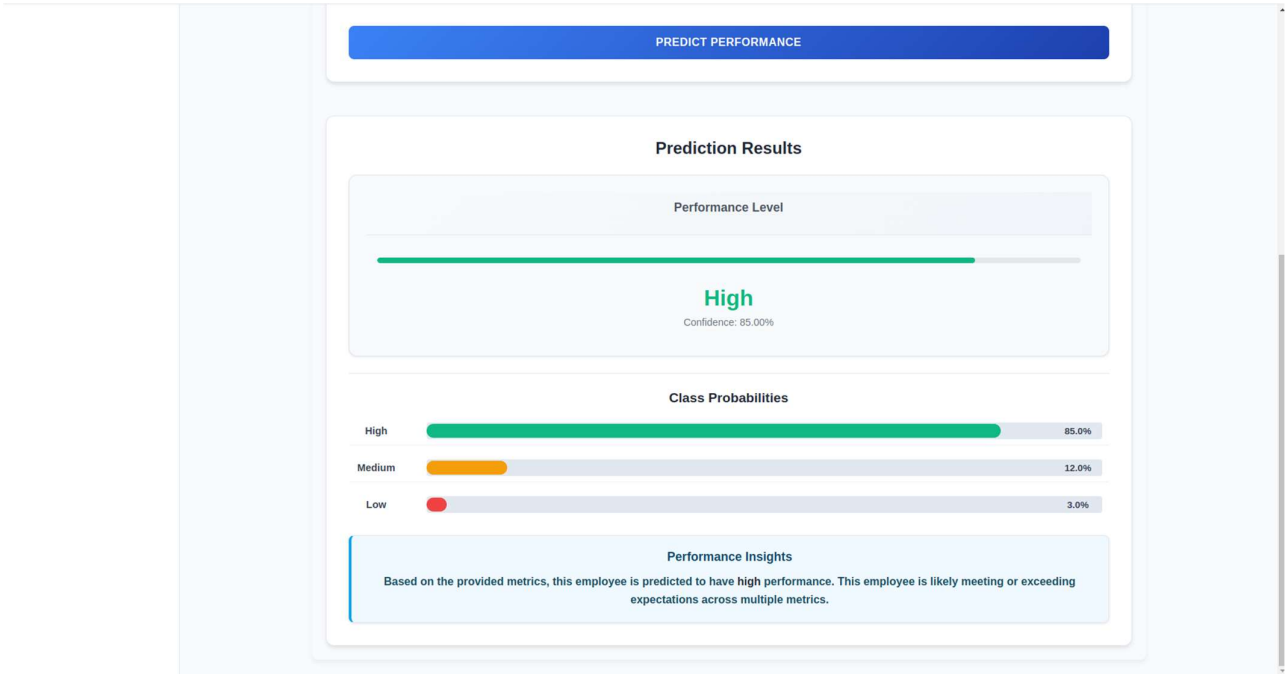

Figure 10: Real-Time Prediction Result Display

iv. **Historical Data Page**

Displays previously entered data and corresponding predictions for tracking and comparison.

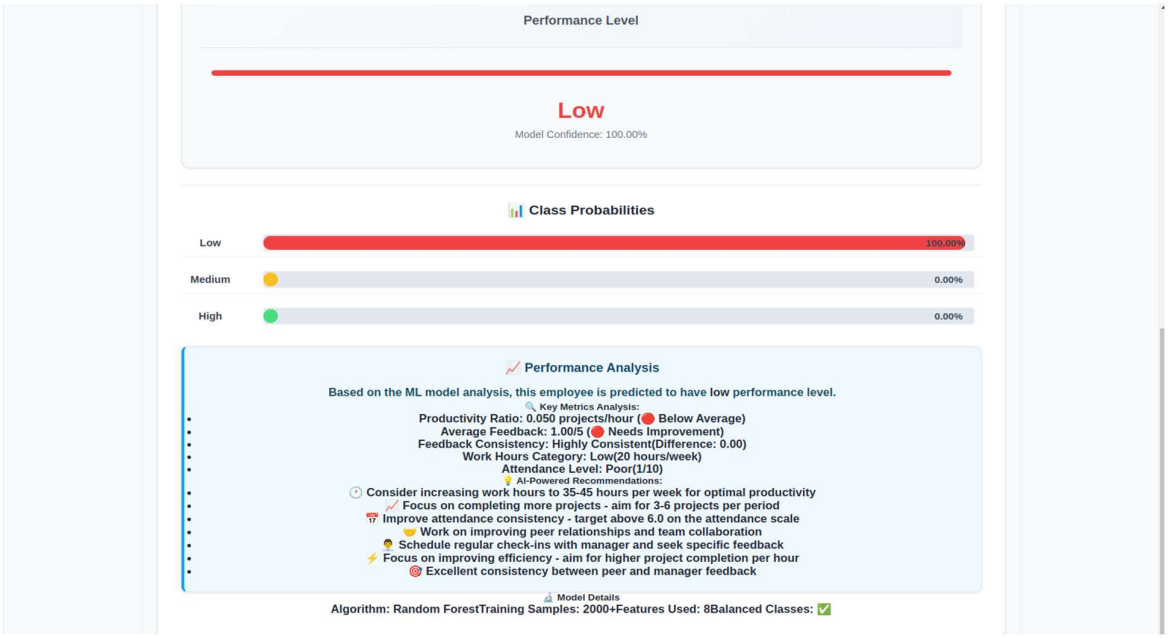

Figure 11: Historical record prediction (low)

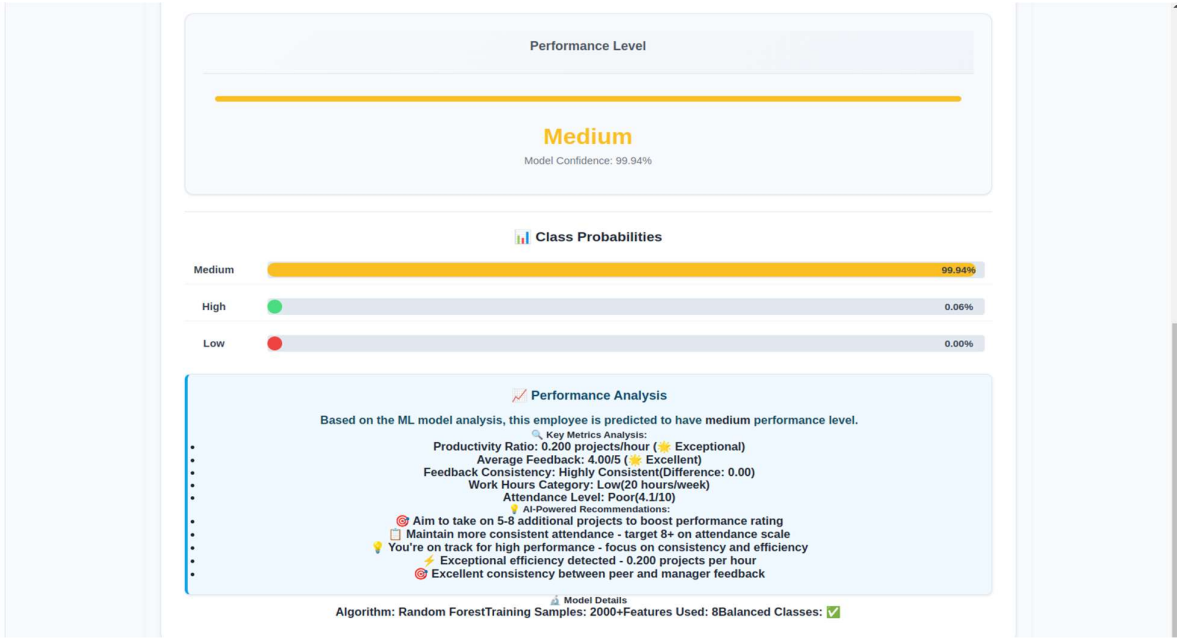

Figure 12: Historical record prediction (medium)

v. **Dashboard Page**

The image below shows the dashboard of an Employee performance tracking web app named EmpPerform Pro**.** This dashboard provides an overview of employee or team performance reports and statistics.

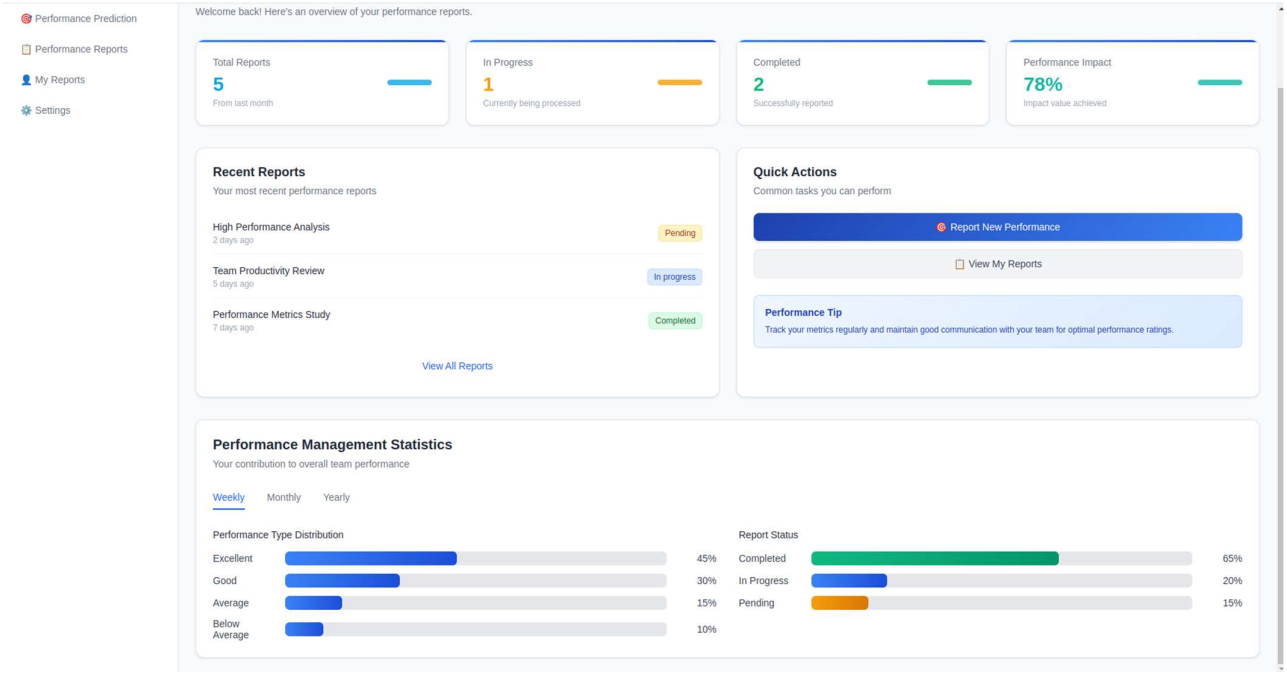

Figure 13: Dashboard display

Each module enhances the overall experience by offering HR personnel a seamless, automated solution to predict and monitor employee performance efficiently.

4.4 Discussion

This section highlights some of the technical and design challenges encountered during development and proposes future improvements to enhance the system's functionality and reach.

4.4.1 Challenges Faced

Several challenges were encountered during the implementation phase, including:

- **ML Model Tuning**: Achieving optimal accuracy from the machine learning model required multiple rounds of feature selection, normalization, and hyperparameter tuning.
- **Frontend-Backend Integration**: Ensuring seamless communication between React and FastAPI presented some difficulties, especially with CORS handling and JSON formatting.
- **UI/UX Design**: Creating an intuitive and professional interface without formal training in UI design posed a significant challenge during the early phases.

4.4.2 Future Improvements

Although the current version of the system meets its core objectives, several enhancements are envisioned for the future:

- **Integration with HRMS**: Enable automatic syncing of employee data from existing HR management systems.
- **Advanced Analytics**: Incorporate dashboards with charts and filters for performance trend analysis.
- **Extended Features**: Add modules for employee feedback, training recommendation systems, and team performance analysis.
- **Mobile Accessibility**: Develop a mobile version of the application for HR managers to use on the go.

CHAPTER V
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, the Employee Performance Prediction System represents a major step forward in enhancing how organizations evaluate and manage employee performance. By leveraging machine learning, this system provides accurate, data-driven predictions that classify employee performance as High, Medium, or Low based on quantifiable metrics such as hours worked, attendance, project completion, and feedback.

Built using modern technologies like FastAPI, React, and Scikit-learn, the system delivers a smooth and efficient user experience for HR managers. The frontend offers a user-friendly interface for entering employee data, while the backend ensures real-time communication with the prediction model for instant and reliable results.

The project's adoption of the Agile methodology allowed for flexible, iterative development, ensuring continuous improvement and adaptability to feedback. Through predictive insights and automation, the system fosters more objective decision-making in areas such as training, promotions, and performance management.

As organizations increasingly rely on technology for operational efficiency, this system is well-positioned to support more transparent, fair, and effective performance evaluation processes. It not only reduces bias but also provides a scalable foundation for future enhancements such as trend analytics and system integration with existing HR platforms.

5.2 Recommendations

While the project successfully met its primary objectives, several challenges particularly those related to model tuning and frontend-backend integration were encountered during development. Looking forward, we recommend the following:

1. **Integration with Enterprise HR Systems**
   To enhance usability, the system should be integrated with HR management software to allow automatic synchronization of employee records and streamline workflows.
2. **Incorporation of More Performance Metrics**
   Future versions of the system should include additional data points such as peer reviews, training completion, and professional certifications for a more holistic evaluation.

3. **Deployment of Advanced Visual Analytics**
   Introducing dashboards with interactive charts and visual summaries would help HR managers analyze trends and make better strategic decisions.
4. **Financial Support for Deployment**
   Additional funding may be required to support secure cloud hosting, deployment, and model optimization for use in larger enterprises.
5. **Promotion of Data-Driven HR Practices**
   Organizations should be encouraged to adopt predictive technologies as part of their HR strategy to move toward more efficient, fair, and transparent decision-making.

By continuing to evolve this system and addressing the above recommendations, the Employee Performance Prediction System has the potential to become a core tool in modern HR practices, ensuring a more productive and data-driven work environment.

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APPENDIX

Github link: https://github.com/Elpavelo/project.git