

Employee Attrition and Layoff Prediction System

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Abstract— Employee turnover and layoff are important issues for organizations, as they have a direct impact on productivity, operational expenses, and business continuity. This project introduces a web-based HR Analytics Dashboard that predicts the risk of employee turnover and layoff based on employee performance-related data. The project is developed using Python and Flask, with SQLite as the backend database to store employee and intervention data. First, secure user login is implemented to allow authorized access to the system. HR administrators are allowed to upload employee data in CSV format, which is automatically processed and validated. After data preprocessing, the system implements a risk scoring model to categorize each employee into Low Risk, Medium Risk, or High Risk groups for both employee turnover and layoff prediction. The predicted outcome is stored in the database and visualized using an interactive dashboard with graphical visualizations such as risk distribution charts and department-wise employee analytics. The system also includes an employee management system with filtering capabilities and an HR intervention system to track interventions for high-risk employees. Moreover, the system includes a professional downloadable PDF report for HR documentation of employee risk analysis. Furthermore, the system provides downloadable PDF reports summarizing key risk information and high-risk employees. In summary, the system enhances HR decision-making by offering automated prediction, visualization, intervention, and reporting support in an efficient manner. Below are the figures showing the key modules of the proposed Employee Attrition and Layoff Prediction System. The designed system has minimized manual labour, enhanced workforce analysis, and offered a trustworthy platform.

I. INTRODUCTION

Employee turnover and layoffs in the workforce have emerged as key issues for organizations in the current competitive business environment. High turnover of employees leads to reduced productivity, increased hiring and training costs, and

workforce instability. Layoffs, on the other hand, impact the workforce and employee morale, making it imperative to have effective human resource management. In most organizations, human resource management decisions are made using manual approaches like spreadsheets and performance appraisals, which are time-consuming and ineffective in detecting potential risks at an early stage.

Predictive analytics, with the increasing use of employee and organizational data, presents a chance to enhance human resource management decisions. Using employee attributes such as age, department, salary, and performance, it is possible to detect patterns related to employee turnover and layoffs. Categorizing employees based on risk groups helps organizations take preventive steps and enhance workforce planning techniques.

To overcome these issues, this project proposes the development of a web-based HR Analytics Dashboard that can automatically process employee data, predict risks, and display results.

The output is presented on a professional dashboard using interactive graphs and statistical views, which assist HR managers in easily analyzing attrition data and department-wise risk distribution. Therefore, the proposed system has immense potential for future development.

II. LITERATURE REVIEW

Employee turnover prediction has been a widely explored topic in Human Resource Analytics because of its relevance to organizational performance and employee retention. Research suggests that job satisfaction, compensation structure,

performance appraisal, work environment, and employee experience are key factors that contribute to employee turnover. Conventional HR practices involve manual assessment techniques, which are cumbersome and inefficient in detecting early warning signs of employee turnover.

To increase the accuracy of employee turnover prediction, researchers have used data mining and machine learning algorithms like Logistic Regression, Decision Trees, Random Forest, Support Vector Machines, and Naïve Bayes classifiers. These algorithms have shown improved results over conventional approaches. Recent studies also emphasize the role of predictive analytics in workforce layoff analysis, where productivity, cost considerations, and performance metrics are critical parameters. However, existing literature on employee turnover prediction largely concentrates on predictive models and does not provide an integrated framework that incorporates secure access, automated data processing, visualization, reporting, and tracking of interventions, thus making way for a complete HR analytics solution.

III. SYSTEM ARCHITECTURE

The proposed Employee Attrition and Layoff Prediction System is developed with a modular structure that integrates employee data collection, storage, prediction, analysis, and decision support. The system structure ensures that the HR-related employee data is processed efficiently and transformed into valuable insights for HR managers.

A. HR Database Layer

The first layer of the system structure is the HR Database Layer, which holds HR-related employee data like employee name, age, department, salary, and performance rating. This data is the most important set of workforce parameters that affect attrition and layoff risks. In the proposed system, this data is obtained either by uploading datasets (CSV files) or by storing employee records.

B. Data Storage Layer

The second layer of the system structure is the data storage layer, which holds all the employee records in a centralized manner. This layer is responsible for storing all the employee data for further processing and analysis. In the proposed system, SQLite database is used to store employee records, predicted risk values, and HR intervention data. This allows rapid access, retrieval, and modification of workforce data.

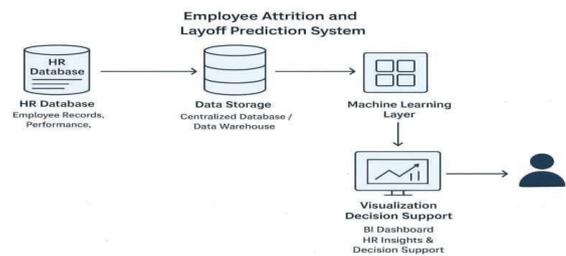


Fig. 1. System Architecture of Attrition and Layoff

C. Prediction Layer

The third layer is the Prediction Layer, which carries out risk assessment and classification. This module processes employee attributes and uses the risk prediction algorithm to predict: Attrition Risk (Low / Medium / High) Layoff Risk (Low / Medium / High) The prediction algorithm is developed using key parameters such as salary range, performance score, and age factor. This module is very important for early warnings about employees who are likely to leave the organization or may be considered for layoffs.

D. Visualization and Decision Support Layer

After prediction, the output is sent to the Visualization and Decision Support Layer. This module offers an interactive dashboard for HR professionals to analyze workforce data. In the proposed system, this layer comprises: Total number of employees display Attrition risk distribution display Department-wise employee analysis Department-wise attrition risk chart This module helps HR managers to analyze trends and determine departments with high attrition risk.

E. HR User Interface Layer

The final layer is the HR Interface, where HR managers can interact with the system. The web application offers a secure login-based interface that allows HR users to: Upload employee datasets View employee details and risk status Download PDF reports.

F. Supporting Modules

To make the system more efficient, other supporting modules are also incorporated into the system design, including: PDF Report Generation Module, which helps to automatically generate downloadable workforce risk reports. HR Intervention Module, where HR managers are able to save their intervention actions and comments for employees. Smart HR Chatbot Module, which helps to support HR users by answering HR-related questions and providing guidance through the system. Authentication and Security Module, which is developed using Flask-Login for secure access and session handling. System Working Flow The

entire system working flow follows the order: Employee Data
→ Database Storage → Risk Prediction → Dashboard
Visualization
→ HR Decision Support This system design ensures

that the system acts as an automated HR analytics system.

IV. SYSTEM IMPLEMENTATION

The proposed Employee Attrition and Layoff Prediction System was designed as a web-based HR analytics application using a client-server architecture. The system is segmented into frontend and backend modules for efficient execution.

A. Frontend Implementation

The frontend was designed using HTML, CSS, and Bootstrap 5 for a responsive and modern design. The frontend modules include login, employee data upload, dashboard visualization, employee listing, HR intervention form, chatbot interface, and report download section. Interactive graphs and charts were designed using Chart.js for visual representation of workforce data, such as the total number of employees, attrition risk distribution, layoff risk levels, and department-wise analysis. The frontend dynamically retrieves processed data from the backend and displays it in an organized and user-friendly manner. Backend Implementation.

The backend is built using the Python Flask framework. The backend performs authentication, data processing, prediction, database operations, and report generation. Secure user authentication is provided using Flask-Login with encrypted password storage. Employee data is uploaded in CSV format and processed using the Pandas library, with validation of the necessary fields before storing the records in a SQLite database using SQLAlchemy ORM. A risk scoring algorithm assesses employee attributes like age, salary, and performance to assign attrition and layoff risk levels into Low, Medium, and High risk categories. The system also provides an intervention tracking feature to store HR actions for high-risk employees. PDF reports are generated using the ReportLab library, allowing HR managers to download summaries of workforce analysis reports. The system provides a systematic workflow of Login → Data Upload → Validation → Risk Prediction → Dashboard Visualization → Intervention Tracking → Report Generation, making it a comprehensive HR decision-support system.

B. System Workflow

The process starts with secure user login, then uploading employee data in CSV form. Once the data is validated, the backend uses a risk prediction algorithm to categorize employees as Low, Medium, and High attrition and layoff risk. The results are presented on an interactive dashboard. HR managers can log interventions for high-risk employees

and produce downloadable PDF reports. Workflow: Login → Upload Data → Validation → Risk Prediction → Dashboard → Intervention → Report Generation.

V. TESTING AND EVALUATION

The system was also tested to ensure that it functions correctly, is accurate, and is secure. The functional test of the system confirmed the functionality of the modules that include login authentication, CSV upload, data validation, risk prediction, dashboard display, intervention recording,

PDF generation. Various input scenarios were employed to test the prediction outcome and error handling mechanisms. The system successfully categorized employees into respective risk groups and produced error-free reports. The application overall functioned correctly and achieved the intended purpose.

VI. RESULTS AND DISCUSSION

The proposed Employee Attrition and Layoff Prediction System was successfully developed as a web-based HR analytics application using Flask and SQLite. The system enables HR users to securely log in, upload employee data via CSV files, and automatically store records into the database after validation. After data processing, the prediction algorithm categorizes employees into Low, Medium, and High risk groups based on criteria such as age, salary, department, and performance. The output is presented on a professional dashboard using interactive graphs and statistical summary views, which assist HR managers in easily analyzing attrition data and department-wise risk distribution. The employee module includes a comprehensive list of employees with predicted risk levels and also enables HR intervention entry for employee retention activities. Furthermore, the system provides downloadable PDF reports summarizing key risk information and high-risk employees. In summary, the system enhances HR decision-making by offering automated prediction, visualization, intervention, and reporting support in an efficient manner. Below are the figures showing the key modules of the proposed Employee Attrition and Layoff Prediction System.

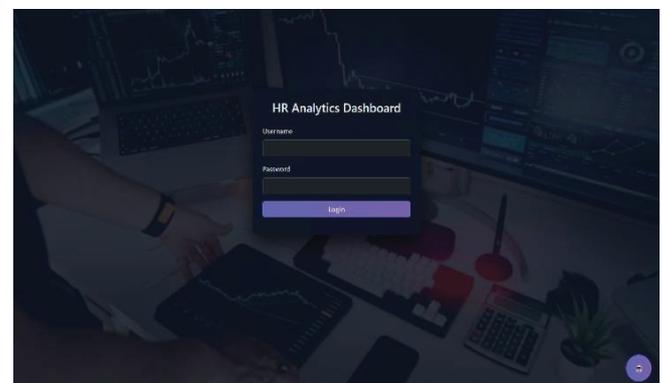


Figure 1: HR Analytics System Login Page



Figure 2: Dashboard Display Showing Total Employees Attrition Risk Statistics

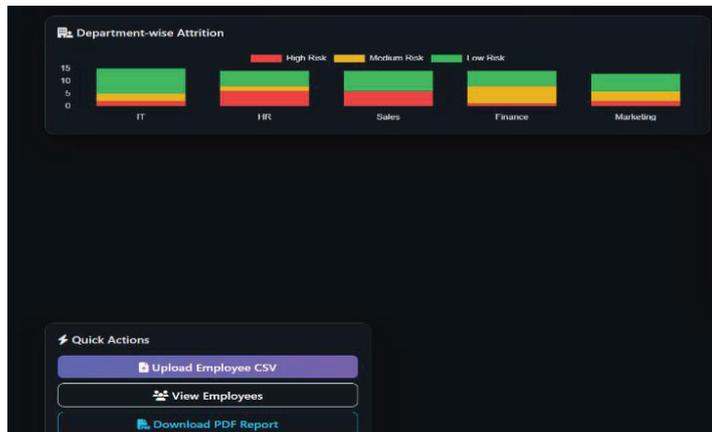


Figure 3: Department-Wise Attrition Risk Prediction Bar Chart Visualization

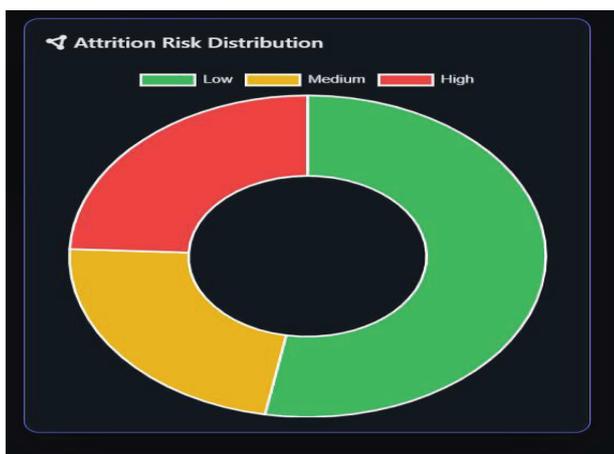


Figure 4: Attrition Risk Distribution Doughnut Chart Representation

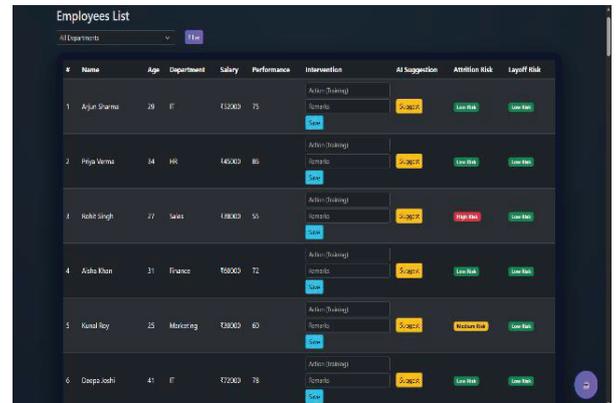


Figure 5: Employee List Module Displaying Employee Data with Attrition and Layoff Risk Status

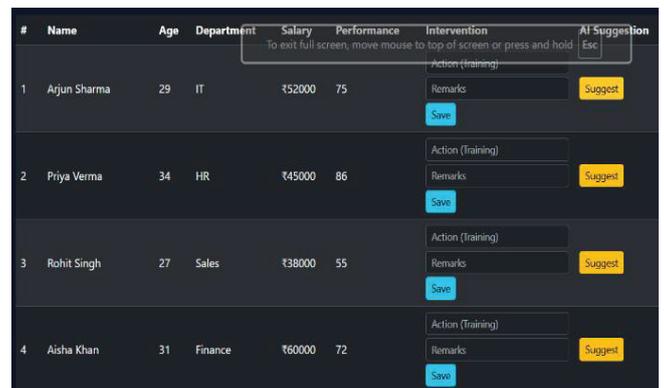


Figure 6: HR Intervention Entry Form for Employee Retention Action Tracking

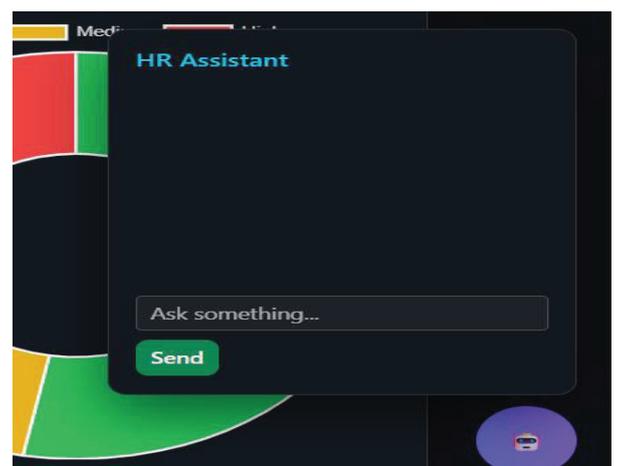


Figure 7: Smart HR Chatbot Interface Integrated into the System



Figure 8: System Navigation Menu Showing Dashboard, Upload CSV, Employees and Report Options

VII. FUTURE SCOPE

The proposed system for Employee Attrition and Layoff Prediction is an effective decision-support system for HR professionals that predicts the risk levels of employees and provides insights through dashboards and reports. Although the system is successfully implemented, there are a few areas of improvement and enhancement that can be considered in the future to make it more advanced and industry-ready.

In the future, the system can be improved by incorporating real-time HR data from enterprise systems such as ERP and HRMS to automatically update the employee data without the need for manual CSV uploads. The prediction algorithm can also be improved by using advanced machine learning and deep learning algorithms such as Random Forest, XGBoost, or Neural Networks.

Moreover, the system can be further enhanced by adding more parameters related to employees, such as job satisfaction, work-life balance, promotion history, and attendance, which will help in making more accurate predictions. Another significant future enhancement of the system is the integration of AI-based personalized intervention recommendations, whereby the system can automatically provide suitable retention strategies for high-risk employees based on their profile and departmental trends. Therefore, the proposed system has immense potential for future development and can be developed into a comprehensive intelligent HR analytics system for real-time workforce management.

VIII. CONCLUSION

In this project, an Employee Attrition and Layoff Prediction System has been successfully designed and implemented to aid HR teams in identifying the employees who are at a risk of leaving the organization or being laid off.

The system successfully acquires employee information through CSV upload, maintains the data in a database, and makes predictions through a risk scoring system based on

critical employee parameters like age, salary, department, and performance.

The designed web application has a modern and interactive HR dashboard where HR managers can access the total number of employees, attrition risk distribution, and department-wise analysis through graphical representation. The system also maintains intervention tracking, where HR teams can log preventive measures for employees with higher risk levels. The application also provides a downloadable PDF report, making it an effective tool for documentation and decision-making.

The designed system has minimized manual labor, enhanced workforce analysis, and offered a trustworthy platform for HR managers to initiate early preventive steps.

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