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Predictive Modelling for Employee Attrition using Machine Learning Techniques

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Abstract: *This study focuses on analyzing employee attrition using data analysis and basic machine learning techniques. The main objective is to identify the key factors that influence employees' decisions to leave the organization. Various factors such as age, salary, job role, department, job satisfaction, and work environment were examined to understand their impact on attrition. The analysis shows that job-related factors like promotion opportunities, salary increments, and work environment play a more important role compared to personal factors such as age and gender. A simple predictive model was also used to estimate the likelihood of employee attrition. The findings of this study can help organizations take better decisions to improve employee retention and reduce turnover*

Keywords: Employee Attrition, HR Analytics, Job Satisfaction, Employee Retention, Machine Learning.

I. INTRODUCTION

Employee attrition has become a major concern for organizations, as it directly affects productivity, cost, and overall performance. When employees leave a company frequently, it leads to increased recruitment and training expenses, as well as loss of experienced talent. Therefore, understanding the reasons behind employee attrition is important for every organization. This study focuses on analyzing employee data to identify the key factors that influence attrition. Various aspects such as salary, job role, department, work environment, and job satisfaction are considered to understand their impact on employee decisions. By using data analysis and basic predictive techniques, the study aims to find patterns and trends related to employee turnover. The main objective of this project is to help organizations understand the major causes of attrition and suggest possible ways to reduce it. By improving working conditions, providing better career opportunities, and ensuring employee satisfaction, companies can retain their employees and achieve long-term success.

II. REVIEW OF LITERATURE

(Srivastava & Patnaik, 2025) state that employee attrition affects organizational stability, productivity, and costs. The study identifies key factors influencing attrition and uses data analytics and machine learning to predict employee turnover, while also emphasizing ethical practices and effective HR strategies for better retention.

(Manju Nandal, 2024) explains that organizations focus on employee retention to reduce recruitment and training costs. The study uses machine learning models on the IBM Watson dataset to predict attrition, and finds that the Feedforward Neural Network (FNN) gives the best performance among all models.

(Kumar, 2024) highlights that employee attrition impacts productivity and profitability. The study compares different machine learning models and finds Gradient Boosting performs best, while factors like age and service length play an important role in attrition.

(Md Sumon Gazi, 2024) explains that machine learning models can be used to predict employee attrition using the IBM HR dataset. Among the models tested, Random Forest performed best and helps organizations identify employees at risk and improve retention.

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(Doohee Chung, 2023) explains that employee attrition causes high costs and loss of knowledge. The study uses the IBM HR dataset and finds that factors like environmental satisfaction, overtime, and relationship satisfaction strongly influence attrition.

(Sandip Das, 2022) explains that employee retention is important for organizational success. The study uses machine learning and explainable AI methods to predict attrition and identify key factors, achieving high accuracy in the results.

(Banerjee, 2022) explains that many existing attrition models fail to capture the real reasons behind employee turnover. The study identifies research gaps and suggests a better approach combining data and human factors to improve understanding and reduce attrition.

(Ali Raza, 2022) explains that employee attrition leads to high costs for organizations. The study uses machine learning to predict attrition and finds that factors like income, job level, and age play an important role, with the Extra Trees model giving the best accuracy.

(Fahad Kamal Alsheref, 2022) explains that employee attrition affects productivity and increases costs. The study uses machine learning models like neural networks and SVM to predict attrition and help organizations take actions to reduce employee turnover.

(Nesrine Ben Yahia, 2021) explains that a data-driven approach using machine learning can effectively predict employee attrition. The study highlights that factors like business travel play an important role in influencing employee turnover.

(Norsuhada Mansor, 2021) explains that employee attrition affects organizational performance. The study compares different models and finds that the SVM model performs best in predicting attrition.

(Gopinath, 2021) explains that employee turnover is a major issue as it leads to loss of valuable knowledge. The study uses HR analytics and a neural network model to predict attrition and improve decision-making in areas like recruitment and retention.

(İrem Ersöz Kaya, 2021) explains that predictive analytics can be used to prevent employee attrition. The study identifies key factors influencing attrition and shows that machine learning models can effectively predict employee turnover.

(Francesca Fallucchi, 2020) explains that AI can support HR decisions by predicting employee attrition. The study finds that the Naïve Bayes model performs best in identifying employees likely to leave.

(Praphula Kumar Jain, 2020) explains that employee attrition is a major issue. The study uses a machine learning model to predict attrition and identify key factors, helping organizations take timely actions to reduce employee turnover.

III. STATEMENT OF PROBLEM

Employee attrition has become a major challenge for organizations as it affects productivity, increases recruitment and training costs, and disturbs the smooth functioning of the organization. In the selected organization, employee turnover creates difficulties in maintaining workforce stability and achieving organizational goals. Various factors such as salary, promotion opportunities, job satisfaction, work environment, and workload influence employees' decisions to leave the organization. Identifying these factors is important to understand the reasons behind employee attrition and to develop effective strategies for employee retention. Therefore, this study focuses on analyzing the factors influencing employee attrition in the selected organization and finding suitable measures to reduce employee turnover.

IV. OBJECTIVE OF THE STUDY

The main objective of this study is to understand employee attrition and the reasons behind it. This study focuses on identifying the important factors that influence employees to leave the organization, such as salary, job role, department, and job satisfaction. It also aims to study the patterns of employee turnover using the given data. A basic prediction method is used to find out which employees are more likely to leave. Finally, the study helps in giving some useful suggestions to reduce attrition and improve employee retention in the organization.

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V. SOURCES OF DATA COLLECTION

The data for this study was collected from the HR Department of Aavin Dairy through secondary sources. The required data was obtained from employee records, HR reports, and organizational documents maintained by the Human Resource Department. These records provided information related to employee details, salary, promotion, job role, experience, and other factors influencing employee attrition. The collected data was used for analysis and to identify the major factors affecting employee attrition in the selected organization.

VI. METHODOLOGY AND TECHNIQUES USED TO PREDICT EMPLOYEE ATTRITION

This study is based on secondary data collected from an employee dataset. The data includes various factors such as age, salary, department, job role, job satisfaction, and years at the company. These variables are used to analyze employee attrition and identify important patterns. The study uses a data-driven approach to analyze and predict employee attrition. The dataset includes various employee-related factors such as age, salary, job role, department, job satisfaction, and years at the company. Initially, the data is preprocessed by handling missing values and converting it into a suitable format for analysis. After preprocessing, exploratory data analysis is performed using basic statistical methods and charts to understand the relationship between different variables and employee attrition. For prediction, a machine learning technique called Logistic Regression is used. This method helps in classifying employees into two categories, whether they are likely to stay or leave the organization. The model is trained using the available dataset and then tested to evaluate its performance. Finally, the results of the model are analyzed to identify the key factors affecting attrition. These findings are useful for organizations to take necessary steps to reduce employee turnover and improve retention.

VII. STATISTICAL ANALYSIS USED TO PREDICT EMPLOYEE ATTRITION

In this study, various statistical analysis methods are used to understand and predict employee attrition. These methods help in analyzing the data in a simple and meaningful way. Descriptive analysis is used to summarize the data by calculating average values, percentages, and distributions of different variables such as age, salary, job satisfaction, and years at the company. This gives a clear overall view of employee characteristics and helps in understanding general patterns in the dataset. Correlation analysis is used to find the relationship between different variables and employee attrition. It shows whether there is a positive or negative relationship between factors such as salary and attrition or job satisfaction and attrition. This helps in identifying which variables are closely related to employee turnover. The t-test is used to compare the mean values between two groups, that is employees who stayed and employees who left the organization. It helps in checking whether the difference between the two groups is statistically significant or not. For example, it can be used to compare the average salary or satisfaction level of both groups. The chi-square test is used to examine the relationship between categorical variables such as gender, department, job role, and attrition. This test helps in understanding whether there is any association between these variables and employee turnover. In addition to these methods, basic data visualization techniques such as charts and graphs are also used to present the data in a clear and understandable way. These visual tools help in identifying patterns and trends easily. Overall, these statistical techniques help in identifying the key factors influencing employee attrition and support the prediction process, which can be useful for organizations to take better decisions for employee retention.

VIII. DATA VISUALIZATION BASED ON FACTORS INFLUENCING ATTRITION

In this study, data visualization techniques are used to represent the data in a clear and understandable way. Different types of charts are used to analyze employee attrition and identify important pattern. A coefficient-based bar graph is used to show the impact of different factors on employee attrition. It helps in identifying which variables have a positive or negative influence on attrition. Overall, these visualization methods make the analysis more clear and help in identifying trends and patterns related to employee attrition.

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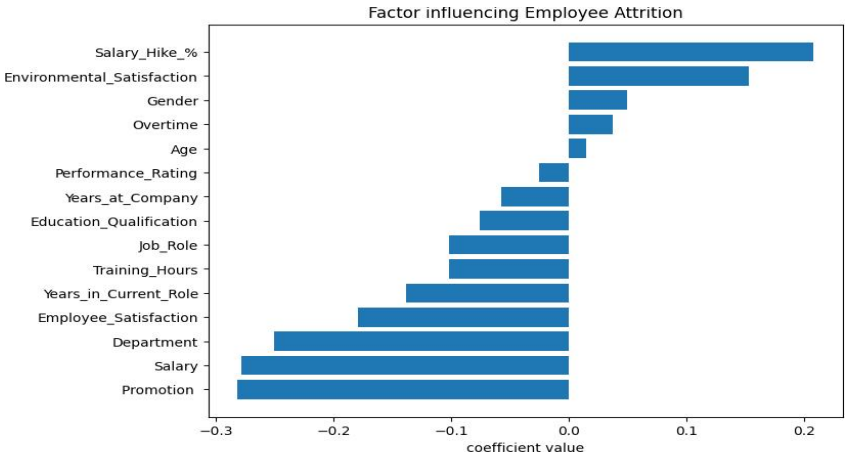

INTERPRETATION

• Positive impact on attrition:

Salary hike percentage and environmental satisfaction show higher positive values, indicating that employees are more likely to leave when salary increments are low or when the work environment is not satisfactory.

• Negative impact on attrition:

Promotion and salary have strong negative values, which means better pay and promotion opportunities help in retaining employees and reduce attrition.

• Minimal impact:

Factors such as overtime, gender, and age show very little influence on employee attrition.

IX. SUMMARY OF FINDINGS

1. Salary Hike (%) is the most influential positive factor in employee retention. Higher salary increments help reduce employee attrition.
2. Environmental Satisfaction has a strong positive impact, showing that a better workplace environment improves employee retention.
3. Gender has a small positive influence on employee attrition, but its impact is comparatively low.
4. Overtime slightly affects attrition, indicating that extra work hours may influence employee decisions.
5. Age has a minor positive effect, showing that employee age has limited influence on attrition.
6. Performance Rating has a very small positive relationship with employee retention.
7. Promotion has the highest negative impact, meaning lack of promotion opportunities increases employee attrition.
8. Salary is a major negative factor, showing dissatisfaction with current pay leads to employee turnover.
9. Department significantly influences attrition, as work conditions may vary across departments.
10. Employee Satisfaction has a negative effect, meaning lower satisfaction increases the chances of leaving.
11. Years in Current Role negatively affects retention, indicating role stagnation can lead to attrition.
12. Training Hours have a moderate negative impact, showing insufficient training may reduce employee engagement.
13. Job Role influences attrition, as some roles may have higher turnover rates.
14. Education Qualification has a small negative influence on attrition.
15. Years at Company has the least negative impact, indicating tenure has a smaller role in attrition.
16. Overall Finding: Compensation, promotions, workplace environment, and satisfaction are the main factors affecting employee attrition. Organizations should focus on these factors to improve employee retention.

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X. RECOMMENDATION AND RETENTION STRATEGIES

Based on the findings of the study, it is recommended that organizations focus on improving employee retention by providing competitive salary packages, regular salary hikes, and performance-based incentives, as compensation is a major factor influencing employee attrition. Companies should also create clear career growth opportunities and ensure timely promotions to enhance employee motivation and commitment. Maintaining a positive and supportive work environment is equally important, as it improves environmental satisfaction and strengthens employee loyalty. Organizations should pay attention to employee satisfaction by encouraging effective communication, recognizing employee contributions, and promoting teamwork. In addition, reducing excessive overtime and managing workload effectively can help minimize work stress and prevent burnout. Providing regular training and development programs can improve employee skills, knowledge, and engagement, leading to better job satisfaction. Management should also identify department-specific issues and improve job roles to reduce dissatisfaction and turnover. Finally, organizations should implement effective retention strategies such as rewards, recognition, employee welfare programs, and work-life balance policies to build a stable workforce and reduce employee attrition.

XI. CONCLUSION

This study was conducted to identify the factors influencing employee attrition in the selected organization. The analysis shows that employee attrition is mainly affected by factors such as salary, salary hike, promotion, employee satisfaction, environmental satisfaction, and job-related conditions. It is found that employees prefer to continue in the organization when they receive good salary increments, better promotion opportunities, and a positive working environment. At the same time, lack of career growth, low salary satisfaction, work pressure, and dissatisfaction with the job increase the possibility of employees leaving the organization. The study clearly indicates that employee retention is important for organizational stability and productivity. Therefore, the organization should focus on improving employee satisfaction, providing career development opportunities, reducing work stress, and implementing effective retention strategies. This will help the organization reduce employee attrition and maintain a stable and committed workforce.

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