

Project Proposal

Nurse Burnout Prediction Using Machine Learning

Merwa Omer Idris Ibrahim
Master's Student, Department of Artificial Intelligence
Midocean University

1. Project Overview

Nurse burnout has become a major challenge to healthcare organizations globally. High workloads, long working hours, emotional stress and staff shortages can have a negative impact on nurses' well-being, job satisfaction and quality of patient care. Early detection of burnout risk allows healthcare institutions to take action before the situation escalates.

This project aims to construct a machine learning model to estimate the probability of nurse burnout from demographic and work-related data. The project will use artificial intelligence techniques to help healthcare administrators identify nurses who may be in danger and improve workplace conditions, leading to better staff well-being and better outcomes for patients.

2. Project Goal

The main goal of this project is to develop an accurate machine learning model for the early prediction of nurse burnout in healthcare settings.

Specific objectives include:

- Identifying the key factors associated with nurse burnout.
- Developing and comparing different machine learning algorithms.
- Evaluating the performance of the developed models.
- Providing a predictive tool that can assist healthcare organizations in early intervention and decision-making.

3. Approach

Explain how you plan to achieve your project goal. This might include:

- **Data Collection:** The project will use data collected through a structured survey distributed to nurses working in healthcare facilities. The survey may include variables such as age, gender, years of experience, weekly working hours, number of night shifts, workload, job satisfaction, and work-life balance.
- **Data Processing:** The collected data will be cleaned and prepared through:

- Handling missing values.
 - Removing inconsistencies and duplicates.
 - Encoding categorical variables.
 - Normalizing numerical data where necessary.
- **Model/Method Selection:** Several machine learning algorithms will be implemented and compared, including:
 - Logistic Regression
 - Decision Tree
 - Random Forest
 - Support Vector Machine (SVM)
 - XGBoost

The best-performing model will be selected based on evaluation metrics.

- **Testing and Evaluation:** The models will be evaluated using:
 - Accuracy
 - Precision
 - Recall
 - F1-Score
 - ROC-AUC Score

Cross-validation techniques will also be used to ensure model reliability and generalization.

4. Project Steps and Timeline

- **Phase 1: Literature Review and Project Planning (weeks 1–2)**
 - Review previous studies on nurse burnout and machine learning applications.
 - Define project requirements and research scope.
- **Phase 2: Data Collection and Preparation (weeks 3–6)**
 - Design and distribute the survey.
 - Collect responses.
 - Clean and preprocess the data.
- **Phase 3: Model Development and Training (weeks 7–10)**
 - Implement selected machine learning algorithms.
 - Train and optimize the models.
- **Phase 4: Testing and Evaluation (weeks 11–12)**
 - Evaluate model performance.
 - Compare results and select the best model.
- **Phase 5: Final Reporting and Documentation (weeks 13–14)**
 - Analyze findings.
 - Prepare the final report and presentation.

5. Expected Results: The expected outcomes of this project include:

- A machine learning model capable of predicting nurse burnout with satisfactory accuracy.
- Identification of the most influential factors contributing to burnout.
- Insights that can support healthcare managers in reducing burnout risks.
- A practical AI-based solution for workforce management in healthcare settings.

6. Resources Needed

Software and Tools: Python, Jupyter Notebook, Scikit-learn, Pandas, NumPy, Matplotlib

Dataset: Survey data collected from nurses.

Hardware: Personal computer with sufficient processing capability.

Support Required:

- Academic supervision.
- Guidance from healthcare professionals for survey design and interpretation of results.

7. References:

1. Maslach, C., & Leiter, M. P. (2016). Understanding the burnout experience: Recent research and its implications for psychiatry. *World Psychiatry*, 15(2), 103–111.
2. Shanafelt, T. D., & Noseworthy, J. H. (2017). Executive leadership and physician well-being. *Mayo Clinic Proceedings*, 92(1), 129–146.
3. Topaz, M., Murga, L., Gaddis, K. M., et al. (2019). Mining fall-related information in clinical notes using machine learning. *Journal of Biomedical Informatics*, 58, 33–40.
4. Géron, A. (2022). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (3rd ed.). O'Reilly Media.