Social Anxiety Prevention Recommender

Presentation

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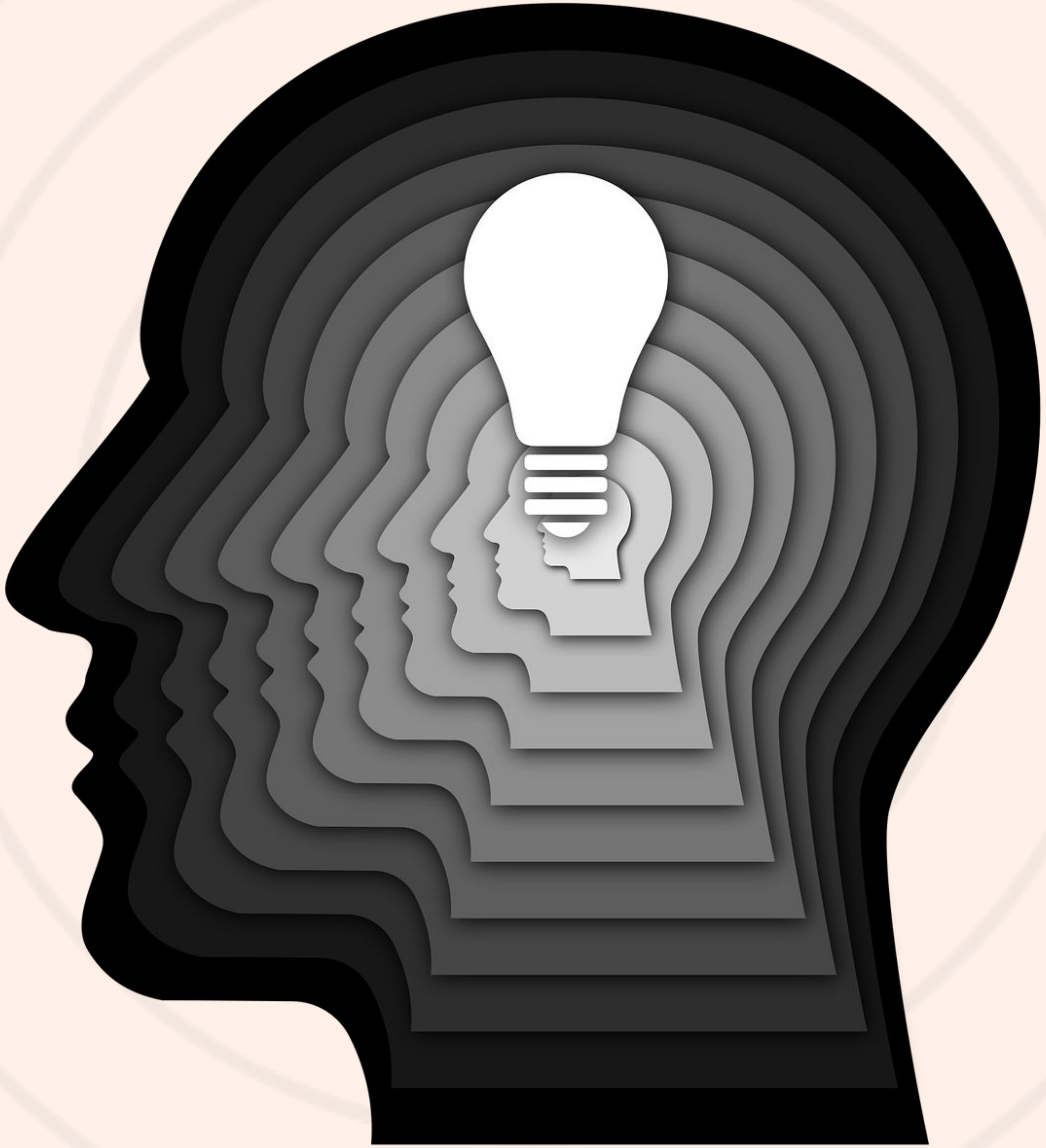

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Problem Statement

With over 5 million Kenyans struggling with anxiety disorders, MindGuard revolutionizes mental health through an intelligent early-warning system.

Using Feedforward Neural Networks to interpret complex behavioral patterns, MindGuard detects anxiety risks and delivers personalized preventative interventions, helping individuals maintain optimal mental wellness before clinical intervention becomes necessary.

Business Objectives

Q1: *Can we create an intelligent early-warning system that accurately predicts who is likely to experience anxiety problems, allowing for timely prevention and support?*

Q2: *How can we provide personalized lifestyle recommendations that are most likely to help individuals reduce their anxiety risk based on their unique profile?*

Q3: *Which lifestyle factors have the biggest impact on anxiety, and how can these insights guide effective prevention strategies and public health initiatives?*

Our Project

Our project aims to develop machine learning models using ensemble methods (**Random Forest, Gradient Boosting)** and **Feed-Forward Neural Networks** to interpret complex behavioral patterns from lifestyle and physiological data.

We aim to create an accurate prediction system that identifies individuals at risk of developing anxiety before clinical intervention becomes necessary, while providing personalized preventative interventions tailored to individual profiles.

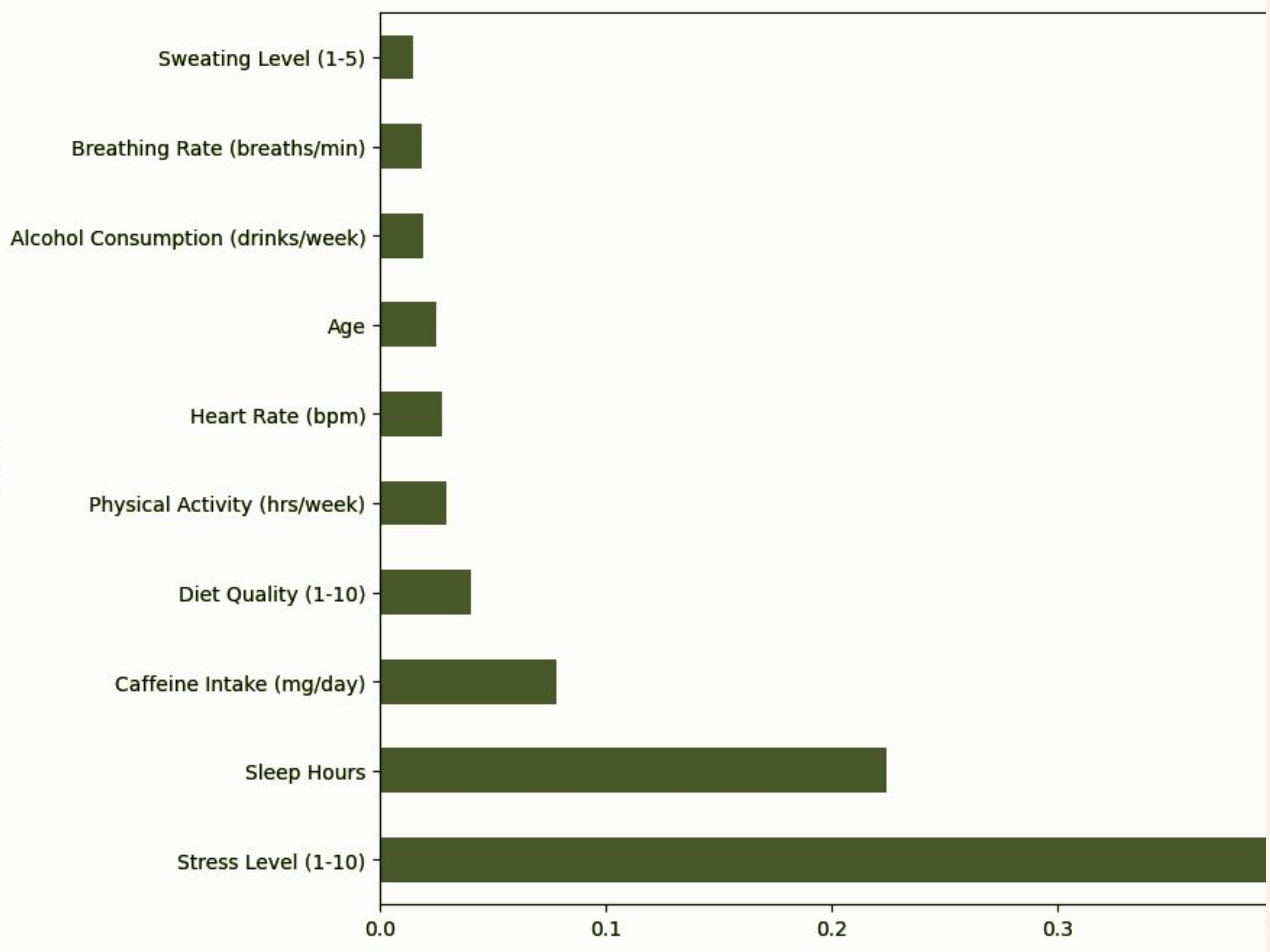
Our methodology involves comprehensive analysis of lifestyle factors including stress levels, sleep patterns, caffeine intake, and diet quality to identify the most impactful predictors for anxiety prevention. The ultimate goal is to deploy interpretable models in digital health platforms that can deliver personalized lifestyle recommendations and guide effective prevention strategies for optimal mental wellness.

Our Numbers

Random Forest Feature importance

Based on the graph, the most important feature is **Stress Level.**

This indicates that stress plays a significant role in anxiety, with **sleep hours** ranking as the second most influential factor.

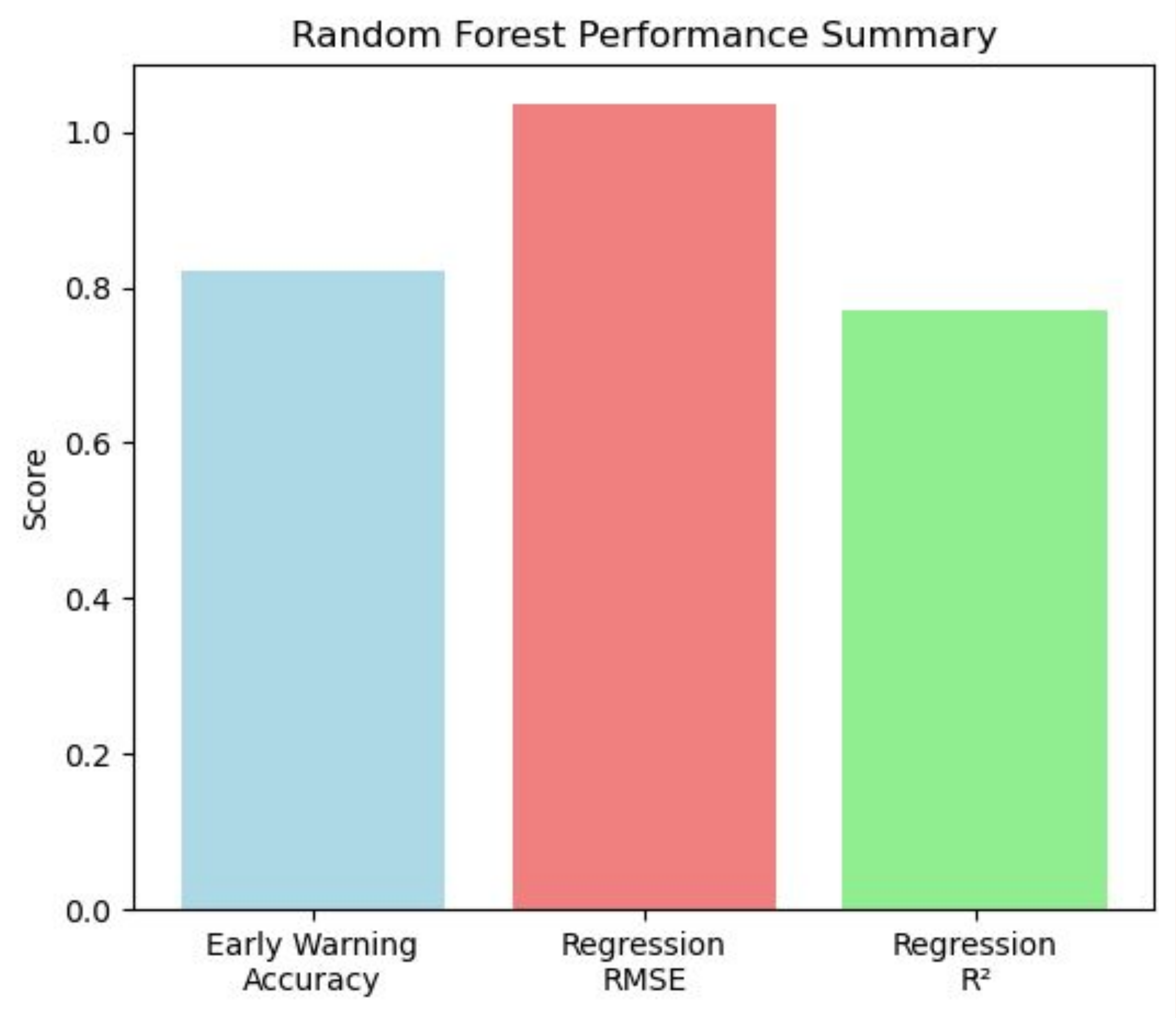


Random Forest Performance Summary

Accuracy: Approx. 82% correctly identifies anxiety levels in 4 out of 5 cases (strong for early warnings).

RMSE: Approx. 1.0 low prediction error, showing good precision.

R^2: Approx 0.77 explains 77% of anxiety variance; key features are highly predictive



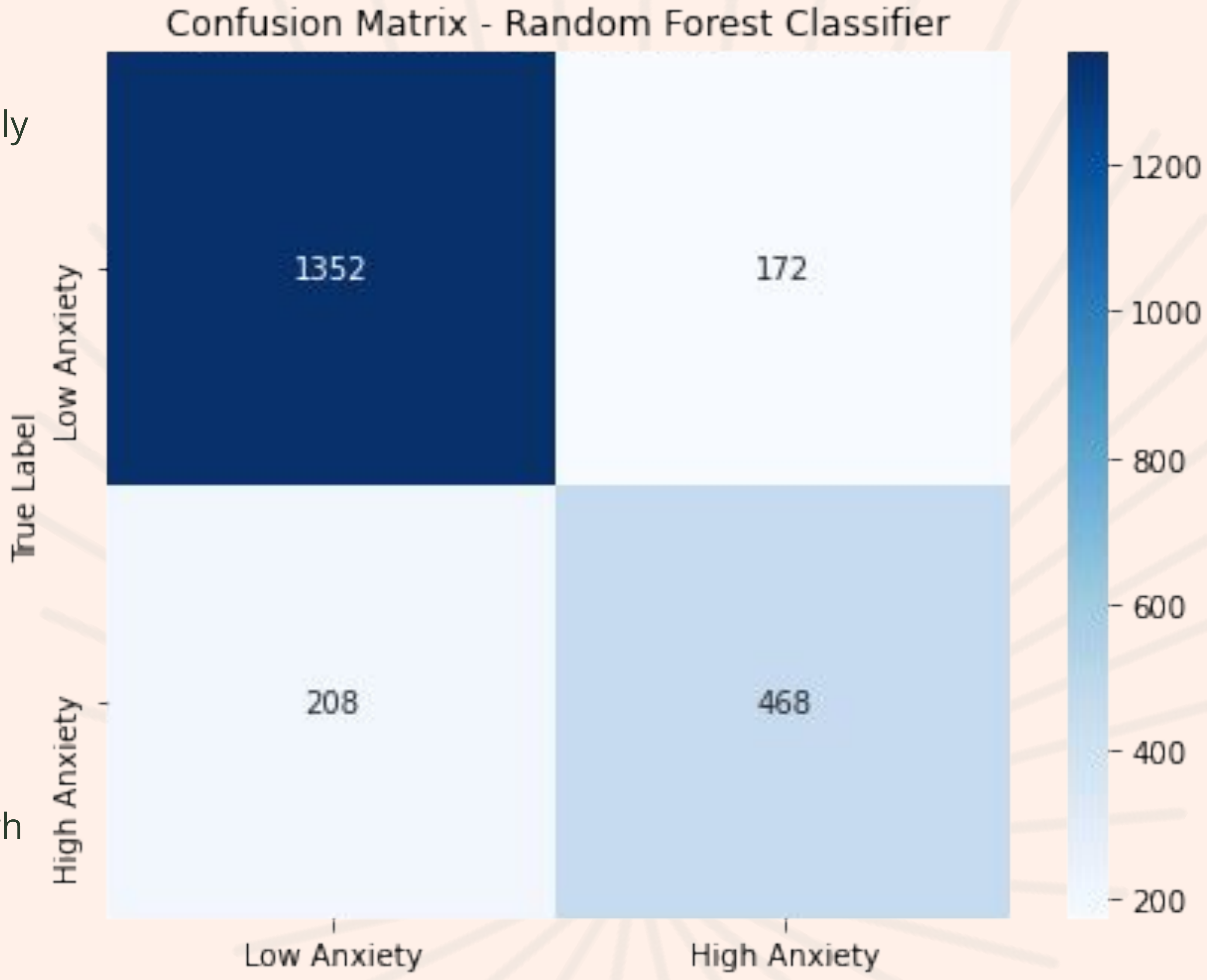
Random Forest Confusion Matrix

True Negatives (1352): Model correctly predicted "Low Anxiety" when the person actually had low anxiety.

False Positives (172): Model predicted "High Anxiety" when the person actually had low anxiety.

False Negatives (208): Model predicted "Low Anxiety" when the person actually had high anxiety.

True Positives (468): Model correctly predicted "High Anxiety" when the person actually had high anxiety

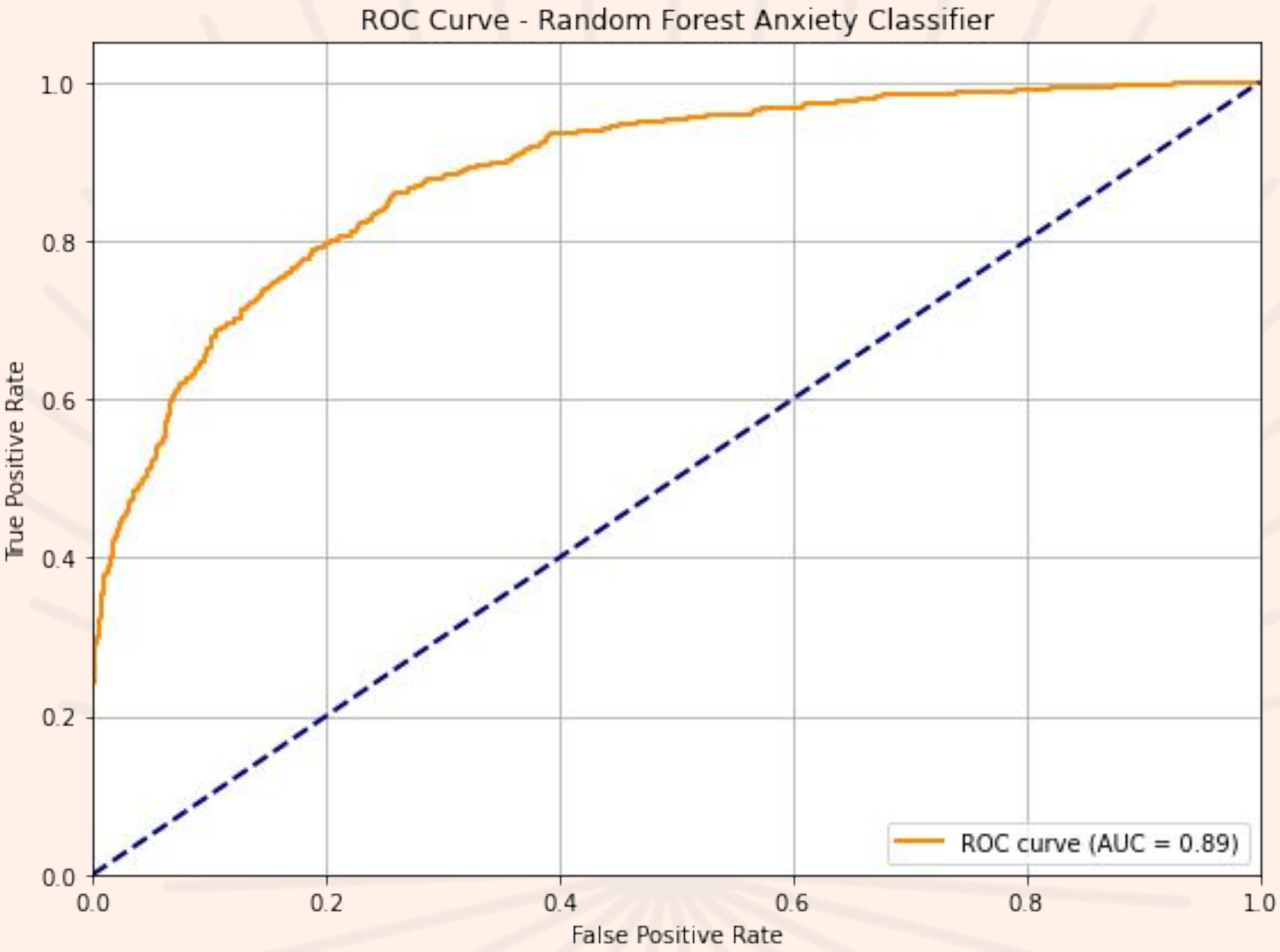


Random Forest ROC Curve

The curve shows how well your model performs across different classification thresholds.

An AUC of **0.89** means the model has a very strong ability to distinguish between individuals with high vs. low anxiety.

The model also performs far above the baseline throughout



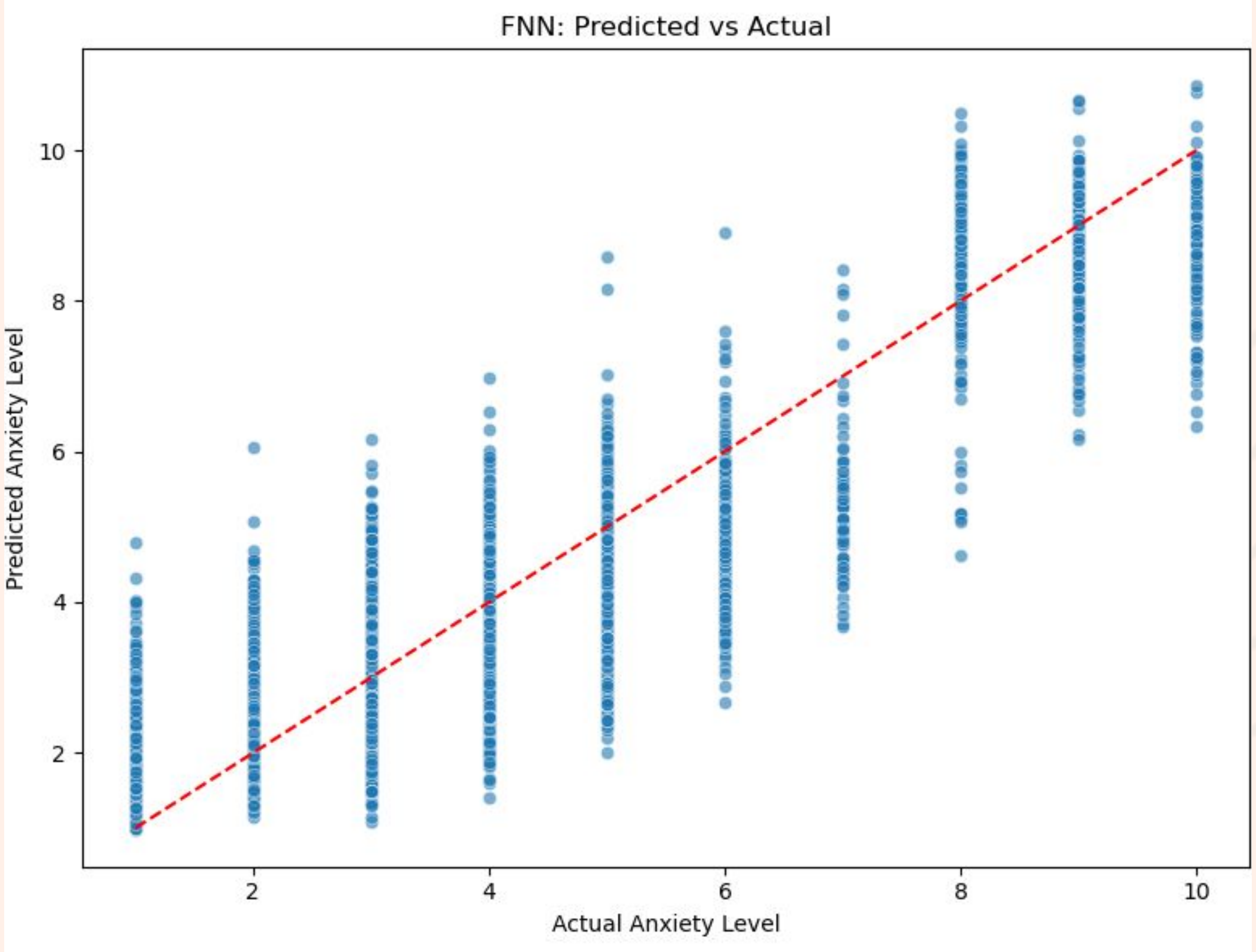
FNN Predicted vs Actual

1. Tight clustering around the red line shows strong agreement between predicted and actual anxiety levels.

2. Spread is consistent across the range, meaning the model performs well across both low and high anxiety scores.

3. Minor vertical scatter indicates some prediction error, but no major bias or drift.

4. Overall, the FNN demonstrates accurate and stable predictions across the full anxiety scale.



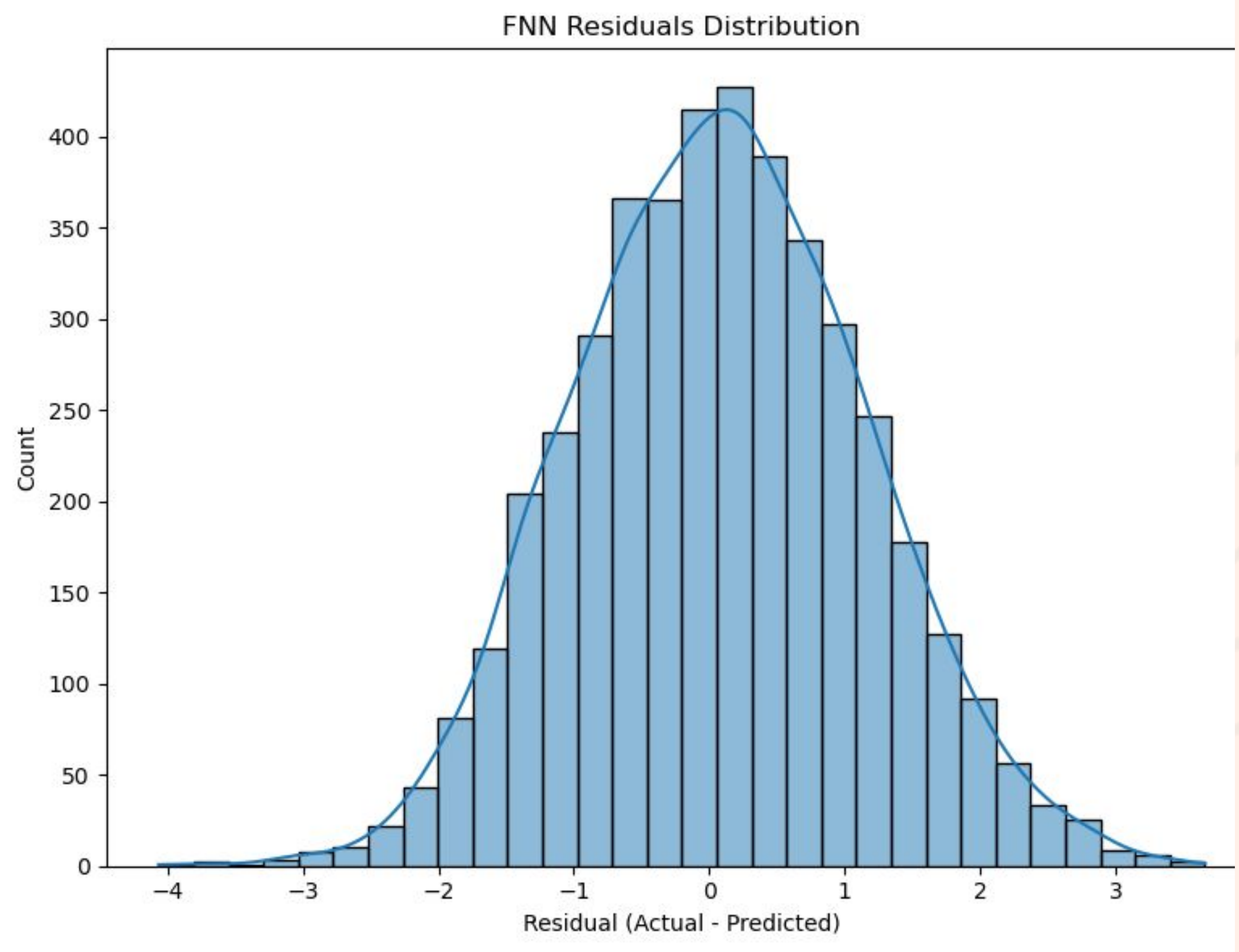
FNN Residual Plot

1. Symmetrical bell shape: The residuals are normally distributed meaning the model makes balanced predictions with no major bias.

2. Centered at 0: On average, the model neither overpredicts nor underpredicts which is the ideal behavior.

3. Tapering ends: Most predictions are close to the actual values; very large errors are rare.

4. Smooth KDE line The kernel density estimation (blue line) follows the histogram closely, confirming stable prediction behavior across data points.



Deployment

We deployed our trained Random Forest model using **FastAPI**, creating a lightweight, efficient **RESTful API** for predicting social anxiety scores.

The app exposes two main endpoints:

- /predict – uses all features (31 total) for full model accuracy
- /predict2 – uses only the top 10 most important features, optimized for speed

The API returns:

- A **predicted anxiety** score (from 0 to 10)
- A **corresponding anxiety** level (e.g., "Moderate Anxiety")
- A note indicating which feature set was used

The deployed app is ready for integration into digital health platforms and can power mobile or web-based mental health screening tools. It supports early detection of anxiety and lays the foundation for adding personalized recommendations in the future.

Conclusion

Early-Warning System: We successfully developed predictive models using ensemble methods (Random Forest, Gradient Boosting) and Feed-Forward Neural Networks that accurately identify individuals at risk of anxiety. The models demonstrated strong predictive capability, laying the foundation for a consumer-focused early-warning system that detects anxiety risk before clinical intervention becomes necessary.

Personalized Recommendations: By analyzing lifestyle data, the models pinpoint which combinations of factors (stress, sleep, caffeine intake) are most impactful for individual users. This enables tailored risk assessments and personalized lifestyle interventions to reduce anxiety risk through targeted behavioral changes.

Key Lifestyle Insights: Feature analysis revealed that non-linear interactions between lifestyle factors are more predictive than individual variables alone, highlighting the importance of holistic behavioral approaches for anxiety prevention and guiding evidence-based wellness strategies.

These outcomes demonstrate machine learning's potential as a powerful tool for proactive mental health management, enabling early identification, personalization, and effective prevention strategies for Kenya's 5+ million individuals affected by anxiety disorders

Recommendations

Based on the feature importance analysis, the most impactful factors for anxiety level are:

1. **Stress Management:** Focus heavily on stress management techniques such as mindfulness, cognitive behavioral therapy (CBT), meditation, yoga and professional counseling techniques to reduce stress, the strongest predictor of anxiety.

2. **Sleep Hygiene:** Inadequate sleep is a significant contributor to anxiety. Encourage sleep hygiene, aim for consistent sleep schedules, and ensure sufficient hours of quality sleep.

3. **Caffeine Reduction:** Limit caffeine consumption, especially for individuals prone to anxiety.

4. **Diet Quality:** Encourage a balanced and nutritious diet, potentially focusing on foods known to support mental well-being.

Next Steps

Integrate Personalized Recommendations

Enhance the API to return actionable lifestyle changes based on individual risk factors (e.g., reduce caffeine, increase sleep).

Deploy Frontend Interface

Build a user-friendly web or mobile interface to make the anxiety prediction system accessible to the public or clinicians.

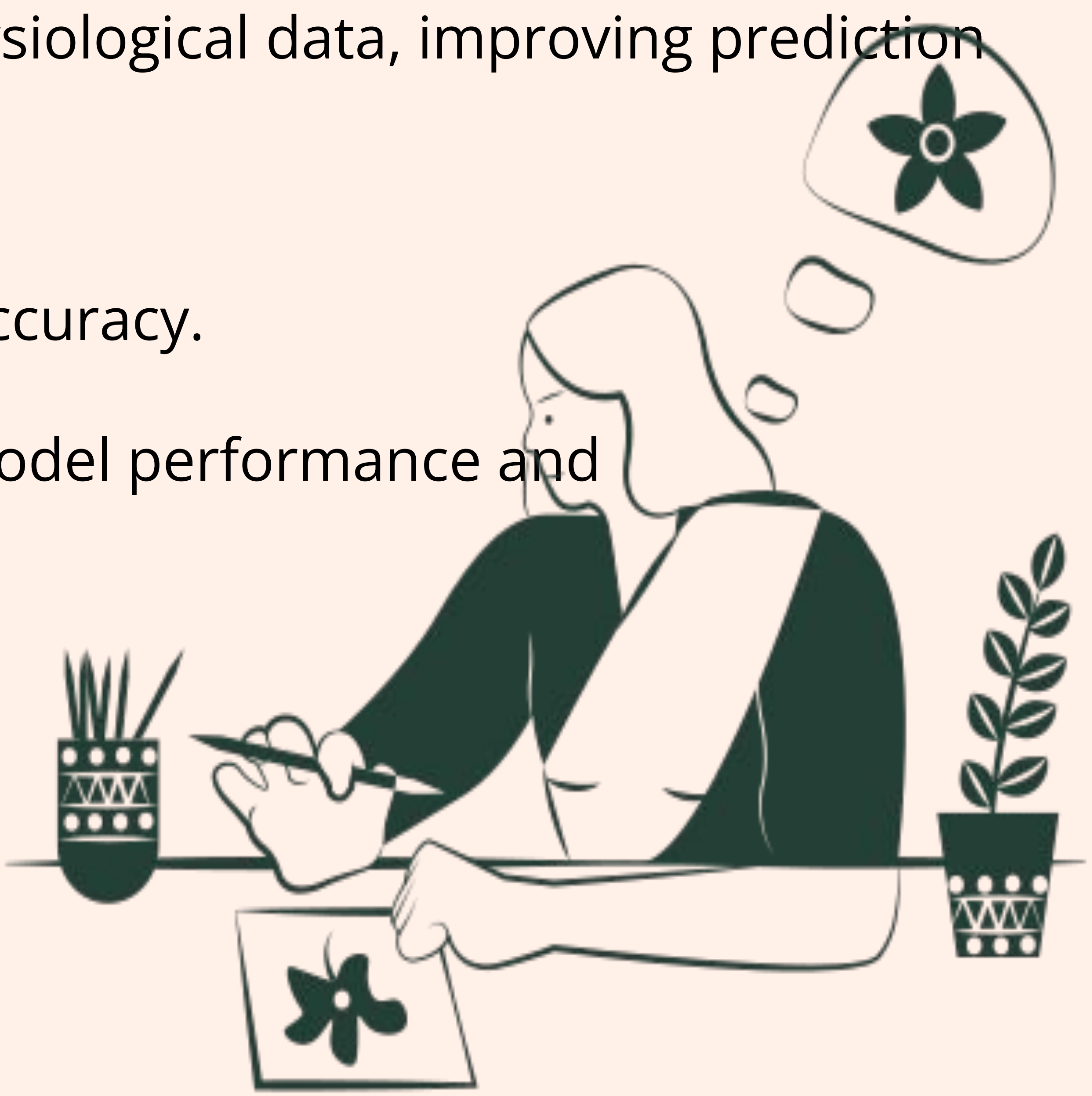
Expand and Retrain with Diverse Datasets

Improve model generalization by incorporating more diverse, real-world data (e.g., across different age groups, cultures, or occupations).

Next Steps

The immediate next steps involve preparing the models for deployment and using their insights to develop practical, personalized anxiety prevention strategies.

- Deploy the models into a user-friendly digital health tool that provides real-time anxiety risk prediction and personalized recommendations to users.
- Enhance the system by integrating wearable devices to collect real-time physiological data, improving prediction accuracy and enabling continuous monitoring.
- Conduct thorough testing of the deployed system to ensure reliability and accuracy.
- Collect user feedback and clinical validation data to continuously improve model performance and recommendation relevance.
- Plan for regular model retraining with new data to maintain robustness and adapt to changing population trends.



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