The University of Lahore

TITLE: AI-BASED DISEASE PREDICTION USING BLOOD SAMPLES.

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DESCRIPTION:

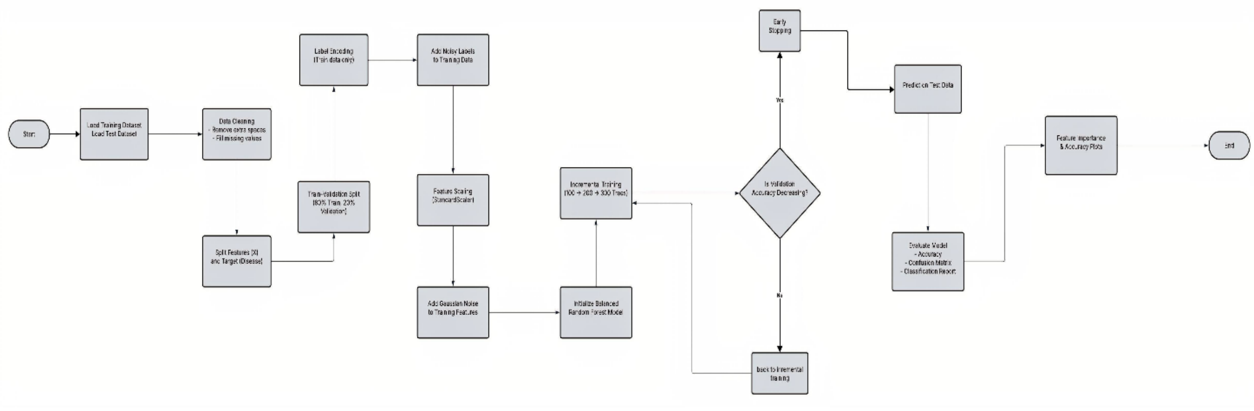
This project focuses on building an AI-based disease prediction system using patient’s blood test data. The goal is to predict possible diseases accurately and fairly, even when some diseases appear less frequently in the dataset. To achieve this, a Balanced Random Forest model is used. Unlike traditional machine-learning models that tend to favor common diseases, this model treats all diseases equally, improving predictions for rare and critical conditions. The system is carefully designed to avoid data leakage, control overfitting, and evaluate performance on completely unseen test data, ensuring that it behaves reliably in real-world medical scenarios.

Beyond just the AI model, the project includes a fully functional backend and frontend, making the system interactive and user-friendly. Patients can input blood test values through the frontend, which communicates with the backend to process the data, run predictions, and return results in real time.

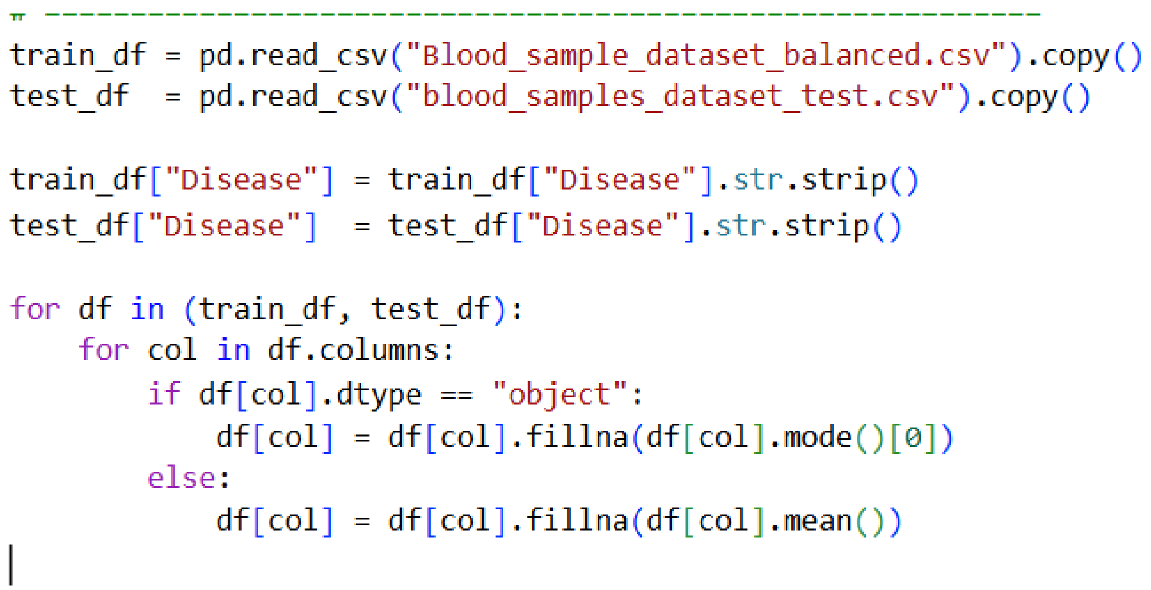
The final system not only predicts diseases but also:

- Shows model accuracy
- Displays a confusion matrix

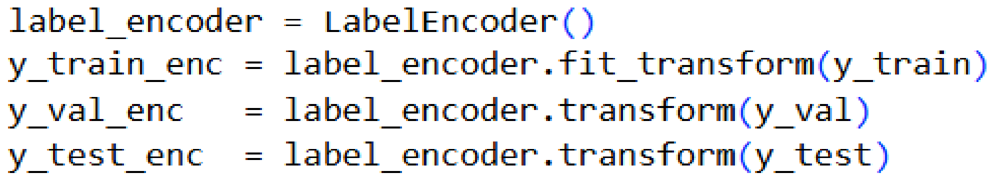
FLOW DIAGRAM:


Start
Load Training Dataset
Load Test Dataset
Data Cleaning
- Remove extra spaces
- Fill missing values
Split Features (X) and Target (Disease)
Train-Validation Split (80% Train, 20% Validation)
Label Encoding (Train data only)
Add Noisy Labels to Training Data
Feature Scaling (StandardScaler)
Add Gaussian Noise to Training Features
Initialize Balanced Random Forest Model
Incremental Training (100 → 200 → 300 Trees)
Is Validation Accuracy Decreasing?
Yes
Early Stopping
No
back to incremental training
Predict on Test Data
Evaluate Model
- Accuracy
- Confusion Matrix
- Classification Report
Feature Importance & Accuracy Plots
End

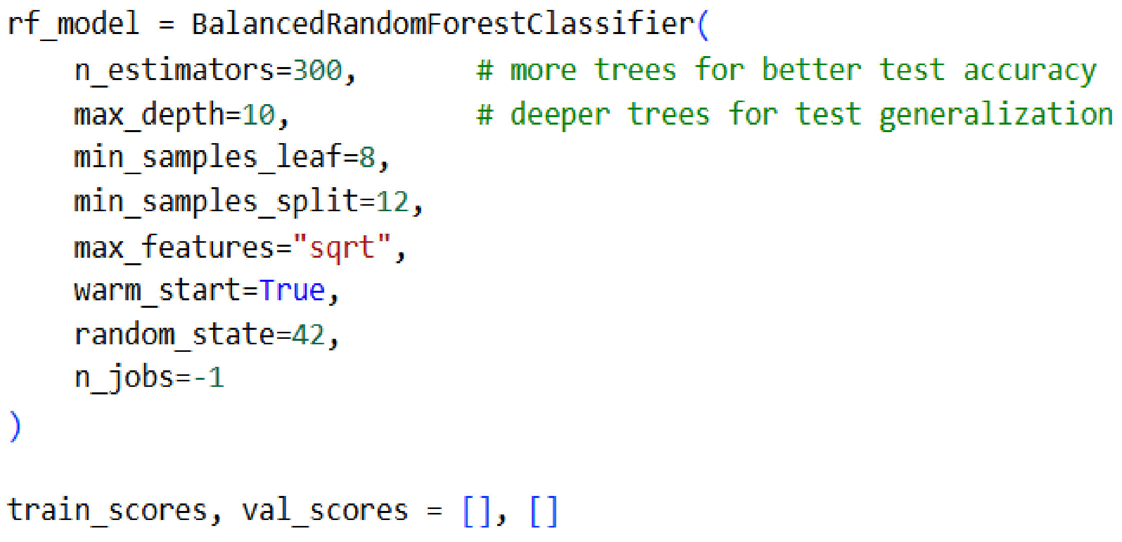
CODE:



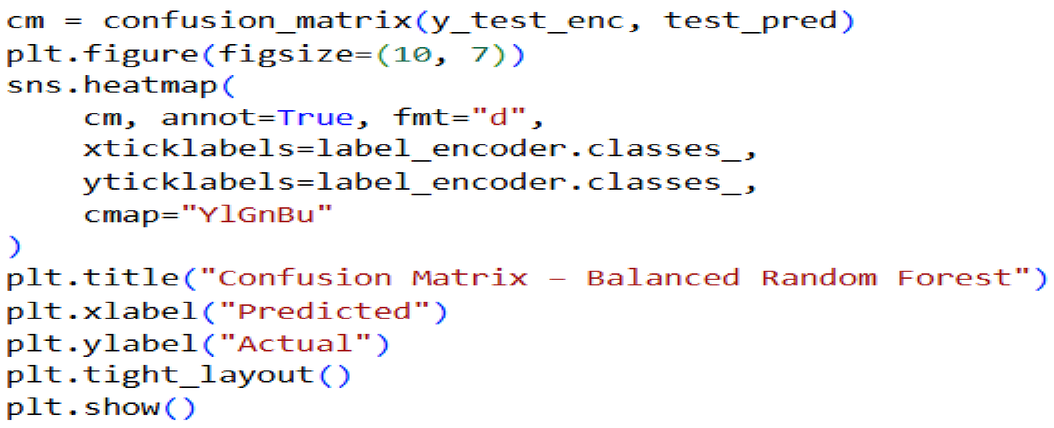
```
# ----------------------------------------------------------
train_df = pd.read_csv("Blood_sample_dataset_balanced.csv").copy()
test_df  = pd.read_csv("blood_samples_dataset_test.csv").copy()

train_df["Disease"] = train_df["Disease"].str.strip()
test_df["Disease"]  = test_df["Disease"].str.strip()

for df in (train_df, test_df):
    for col in df.columns:
        if df[col].dtype == "object":
            df[col] = df[col].fillna(df[col].mode()[0])
        else:
            df[col] = df[col].fillna(df[col].mean())
```



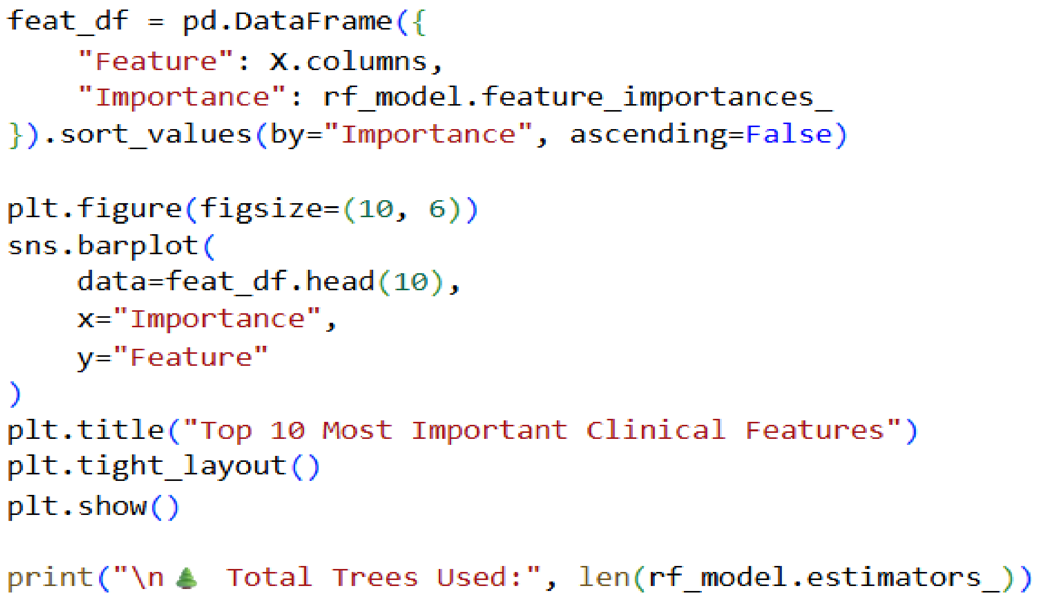
```
label_encoder = LabelEncoder()
y_train_enc = label_encoder.fit_transform(y_train)
y_val_enc    = label_encoder.transform(y_val)
y_test_enc   = label_encoder.transform(y_test)
```



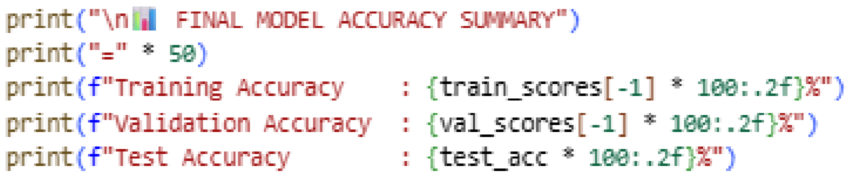
```
rf_model = BalancedRandomForestClassifier(
    n_estimators=300,       # more trees for better test accuracy
    max_depth=10,           # deeper trees for test generalization
    min_samples_leaf=8,
    min_samples_split=12,
    max_features="sqrt",
    warm_start=True,
    random_state=42,
    n_jobs=-1
)

train_scores, val_scores = [], []
```



```
cm = confusion_matrix(y_test_enc, test_pred)
plt.figure(figsize=(10, 7))
sns.heatmap(
    cm, annot=True, fmt="d",
    xticklabels=label_encoder.classes_,
    yticklabels=label_encoder.classes_,
    cmap="YlGnBu"
)
plt.title("Confusion Matrix – Balanced Random Forest")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.tight_layout()
plt.show()
```

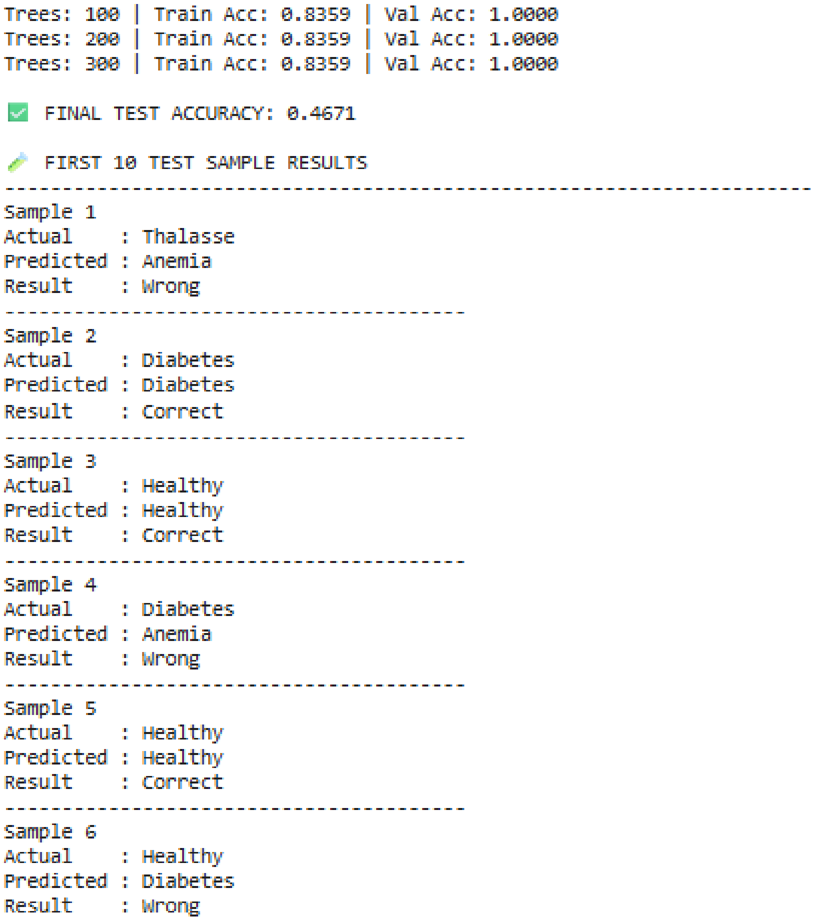


```
feat_df = pd.DataFrame({
    "Feature": X.columns,
    "Importance": rf_model.feature_importances_
}).sort_values(by="Importance", ascending=False)

plt.figure(figsize=(10, 6))
sns.barplot(
    data=feat_df.head(10),
    x="Importance",
    y="Feature"
)
plt.title("Top 10 Most Important Clinical Features")
plt.tight_layout()
plt.show()

print("\n🌲 Total Trees Used:", len(rf_model.estimators_))
```

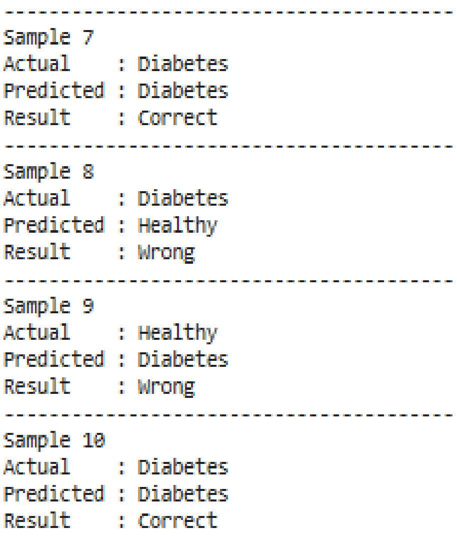


```
print("\n📊 FINAL MODEL ACCURACY SUMMARY")
print("=" * 50)
print(f"Training Accuracy    : {train_scores[-1] * 100:.2f}%")
print(f"Validation Accuracy  : {val_scores[-1] * 100:.2f}%")
print(f"Test Accuracy        : {test_acc * 100:.2f}%")
```

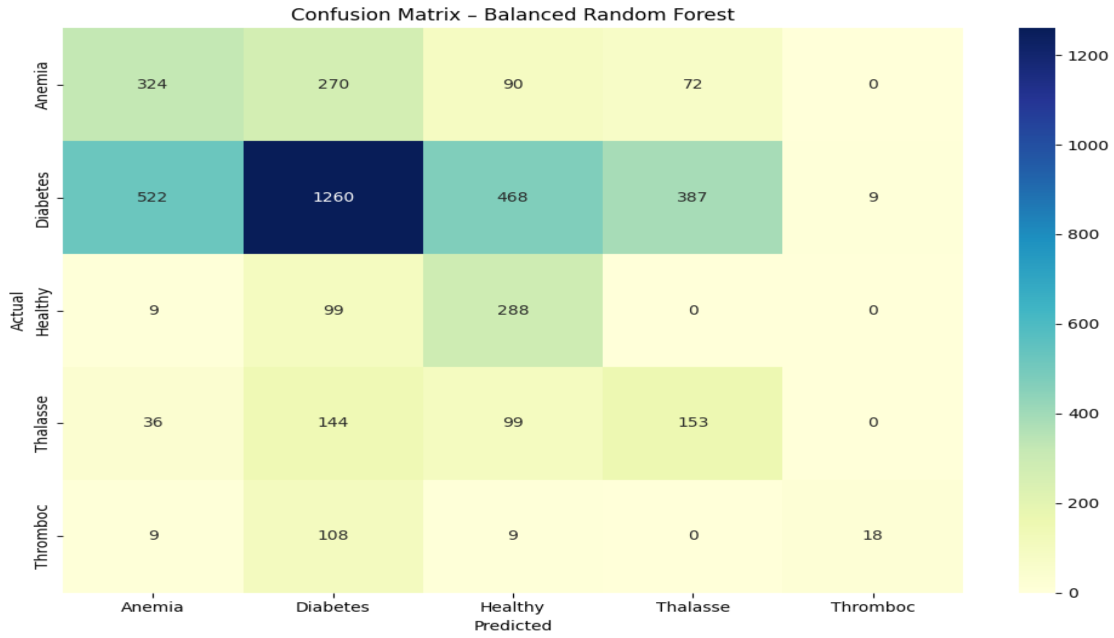
OUTPUT:

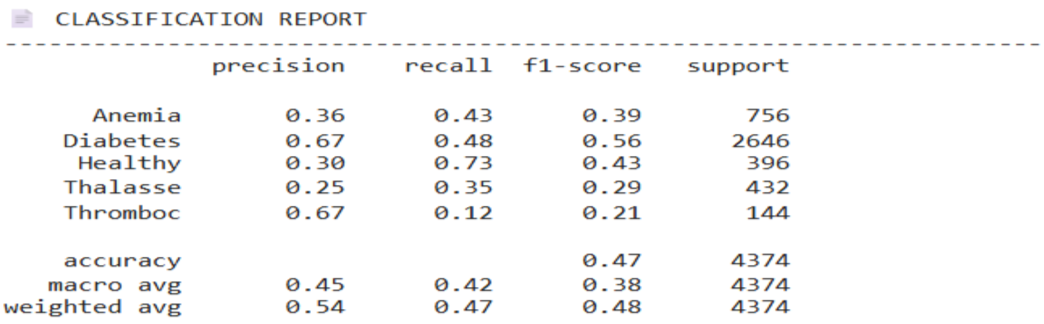


```
Trees: 100 | Train Acc: 0.8359 | Val Acc: 1.0000
Trees: 200 | Train Acc: 0.8359 | Val Acc: 1.0000
Trees: 300 | Train Acc: 0.8359 | Val Acc: 1.0000

✅ FINAL TEST ACCURACY: 0.4671

🧪 FIRST 10 TEST SAMPLE RESULTS
----------------------------------------------------------------------
Sample 1
Actual    : Thalasse
Predicted : Anemia
Result    : Wrong
----------------------------------------
Sample 2
Actual    : Diabetes
Predicted : Diabetes
Result    : Correct
----------------------------------------
Sample 3
Actual    : Healthy
Predicted : Healthy
Result    : Correct
----------------------------------------
Sample 4
Actual    : Diabetes
Predicted : Anemia
Result    : Wrong
----------------------------------------
Sample 5
Actual    : Healthy
Predicted : Healthy
Result    : Correct
----------------------------------------
Sample 6
Actual    : Healthy
Predicted : Diabetes
Result    : Wrong
```

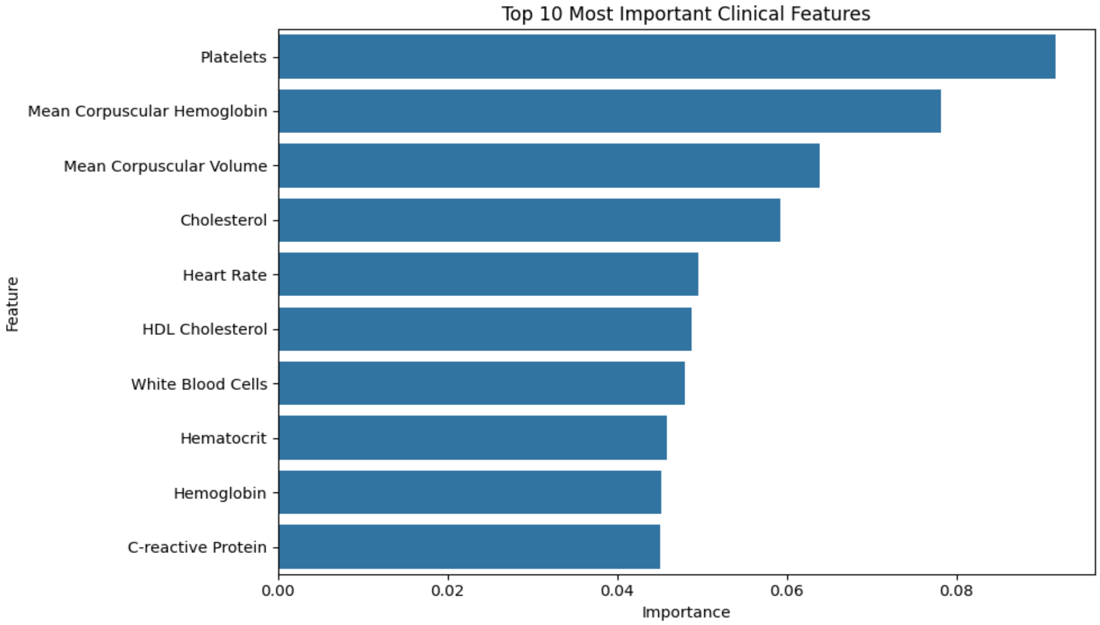


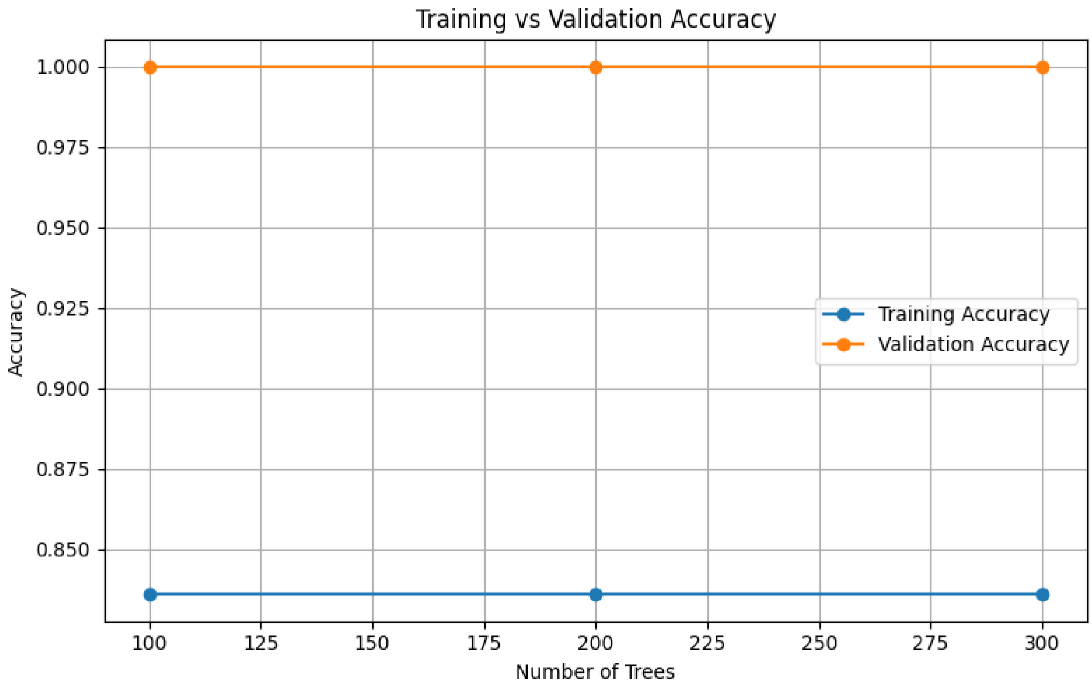
```
----------------------------------------
Sample 7
Actual    : Diabetes
Predicted : Diabetes
Result    : Correct
----------------------------------------
Sample 8
Actual    : Diabetes
Predicted : Healthy
Result    : Wrong
----------------------------------------
Sample 9
Actual    : Healthy
Predicted : Diabetes
Result    : Wrong
----------------------------------------
Sample 10
Actual    : Diabetes
Predicted : Diabetes
Result    : Correct
```

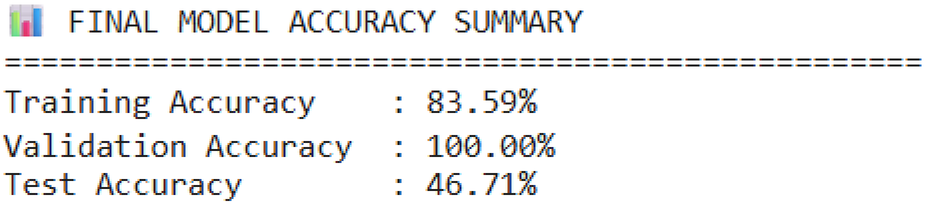




```
📄  CLASSIFICATION REPORT
-----------------------------------------------------------------------
                precision    recall  f1-score   support

      Anemia       0.36      0.43      0.39       756
    Diabetes       0.67      0.48      0.56      2646
     Healthy       0.30      0.73      0.43       396
    Thalasse       0.25      0.35      0.29       432
    Thromboc       0.67      0.12      0.21       144

    accuracy                           0.47      4374
   macro avg       0.45      0.42      0.38      4374
weighted avg       0.54      0.47      0.48      4374
```

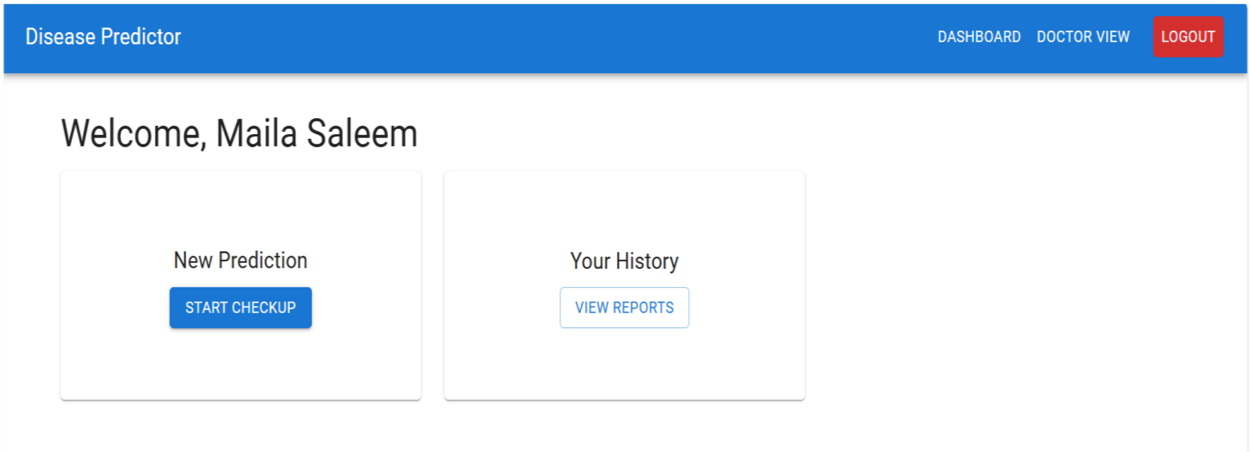




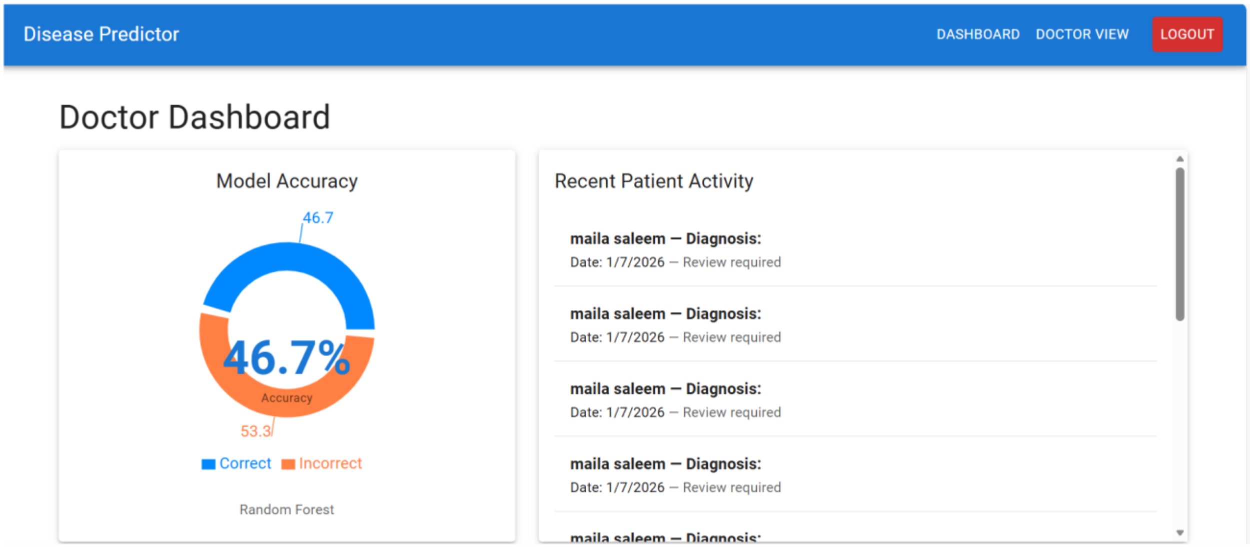


```
📊 FINAL MODEL ACCURACY SUMMARY
==================================================
Training Accuracy     : 83.59%
Validation Accuracy   : 100.00%
Test Accuracy         : 46.71%
```

USER INTERFACE:



Welcome, Maila Saleem



Disease Predictor

Doctor Dashboard

Model Accuracy

Random Forest

Recent Patient Activity

maila saleem — Diagnosis:
Date: 1/7/2026 — Review required

maila saleem — Diagnosis:
Date: 1/7/2026 — Review required

maila saleem — Diagnosis:
Date: 1/7/2026 — Review required

maila saleem — Diagnosis:
Date: 1/7/2026 — Review required

maila saleem — Diagnosis:

SCOPE:

- Dataset cleaning and preprocessing
- Handling missing values properly
- Implementing leakage-safe scaling
- Label encoding without test contamination
- Applying noise injection to avoid overfitting
- Training Balanced Random Forest model
- Incremental tree training with early stopping
- Model evaluation on validation and test data
- Visualization of results
- Feature importance analysis

Git link: https://github.com/mailasaleem67/AI-PROJECT.git