Summary Report

Diabetes Risk XAI Project

Project Title : Predicting Diabetes Risk Using Explainable AI (XAI)
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1. Overview

This project delivers an end-to-end, fully explainable machine-learning system designed to estimate diabetes risk and present clear, interpretable insights that support early intervention. Using the Pima Indians Diabetes Dataset, the system integrates strong predictive modeling with transparent explanations using **SHAP** and **LIME**, ensuring that risk predictions are not only accurate but also easily understood by clinicians, patients, and non-technical decision-makers.

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2. Motivation

Diabetes remains one of the world's fastest-growing chronic diseases. Early detection significantly reduces complications, yet many individuals lack access to screening tools. This project addresses this gap by delivering:

- A **lightweight, accessible prediction system**
- **Human-friendly explanations** for every prediction
- A web-based app that enables real-time evaluation

The system supports awareness, clinical decision-making, and public-health screening initiatives.

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3. Data & Methodology

- **Dataset:** Pima Indians Diabetes Dataset (768 samples, 8 clinical features)
- **Key Features:** Glucose, BMI, Age, Pregnancies, Blood Pressure
- **Pipeline:**

    1. Data validation & preprocessing
    2. Exploratory Data Analysis (EDA)
    3. Baseline modeling
    4. Hyperparameter tuning (XGBoost)
    5. Explainability using SHAP + LIME
    6. Deployment via Streamlit

The workflow ensures reproducibility, reliability, and traceability through structured milestone folders and version-controlled outputs.

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4. Modeling & Performance

After testing multiple algorithms, **tuned XGBoost** emerged as the top-performing model, offering:

- **High recall** (important for medical screening)
- Strong ROC-AUC
- Stability across random splits

The model was further analyzed using global and local XAI methods. SHAP plots identified **glucose** as the dominant predictor, with BMI and age also playing significant roles. LIME reinforced case-specific explanations for individual predictions.

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5. Explainability Impact

The system integrates two complementary interpretability layers:

- **SHAP summary & force plots** show global feature impact and individual risk drivers.
- **LIME case explanations** highlight local decision boundaries for specific patients.

This dual-layer explanation system enhances transparency and aligns with clinical expectations for responsible AI.

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6. Deployment

A fully interactive web application was built using **Streamlit**, providing:

- User-controlled input fields
- Real-time diabetes risk prediction
- Visual XAI explanations (SHAP + LIME)
- Clean, intuitive layout
- Deployment-ready structure for cloud hosting

App URL: [Click Here]

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7. Key Achievements

- Complete end-to-end ML pipeline
- Strong predictive model with medically aligned insights
- Explainable risk dashboard
- Polished documentation across milestones
- Production-like deployment architecture

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8. Future Directions

- Integrate live clinical datasets for model validation
- Expand feature set using electronic health records (EHR)
- Local-language app versions (Arabic, Somali, Swahili)
- Deploy cloud API for mobile/clinic integration
- Improve calibration for clinical decision thresholds