Project Design Phase

The **Project Design Phase** defines the **logical, technical, and functional structure** of the Liver Cirrhosis Prediction System. It ensures that the proposed machine learning solution not only addresses the right clinical challenges but is also **scalable, maintainable, and aligned with healthcare data management standards**.

This is the phase where validated healthcare problems transform into **structured, scalable, and clinically implementable solutions**.

In our project, **“Revolutionizing Liver care: Predicting Liver Cirrhosis Using Advanced Machine Learning”**, this phase bridges the gap between ideation and execution by converting insights from the requirement analysis into a well-designed, intelligent prediction system..

🔹 Problem–Solution Fit

Problem Recap:

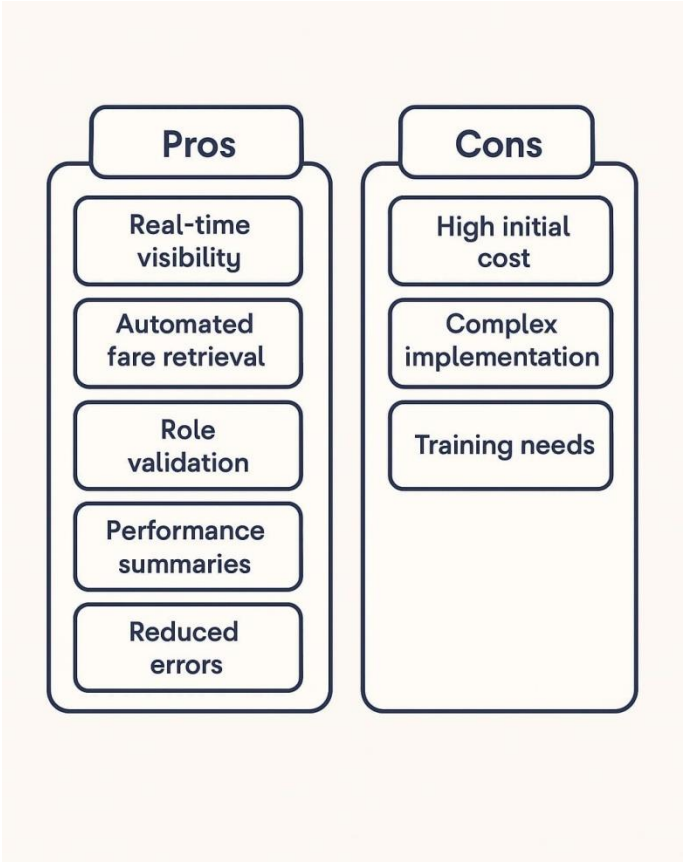
The healthcare system, especially in liver care, faces significant challenges:

- **Delayed diagnosis** due to manual risk assessments.
- **Data fragmentation** across multiple systems and medical records.
- **Inconsistent tracking** of patient liver health progression.
- **Limited decision support** for clinicians managing large patient volumes.

Does the Proposed Solution Fit?

Yes. The Advanced ML-Powered Liver Cirrhosis Prediction System:

- Introduces **structured clinical data management** for Patients, Clinical Tests, Risk Factors, and Prediction Scores.
- Enables **automated risk prediction** through real-time machine learning pipelines.
- Validates **clinical data entries** using automated logic to ensure accuracy and completeness.
- Summarizes **patient outcomes and population risk trends** using interactive dashboards and clinical reports.
- **Reduces manual calculation errors** through machine learning-based risk scoring.
- **Provides centralized, real-time patient views** via a user-friendly clinical interface (Web App or Dashboard).



🔹 Proposed Solution

How Our ML-Powered System Will Solve the Identified Problems

Our proposed **Liver Cirrhosis Prediction System** is designed to digitize, streamline, and intelligently predict liver disease progression using **advanced machine learning models and automated clinical workflows.**

Key Functional Features:

● Custom Clinical Data Entities:

- **Patient Profile:** Demographics, lifestyle, and medical history
- **Clinical Test Results:** Liver function tests, imaging reports, lab values
- **Risk Factors:** Alcohol use, obesity, viral infections, genetic predisposition
- **Prediction Scores:** Automated risk levels generated by ML models

● Automation & Data Validation:

- **Clinical Data Validation:** Ensures completeness and accuracy using automated logic
- **Automated Risk Prediction:** Real-time ML-based risk scoring upon data entry
- **Input Control:** Automated alerts for missing or out-of-range clinical values

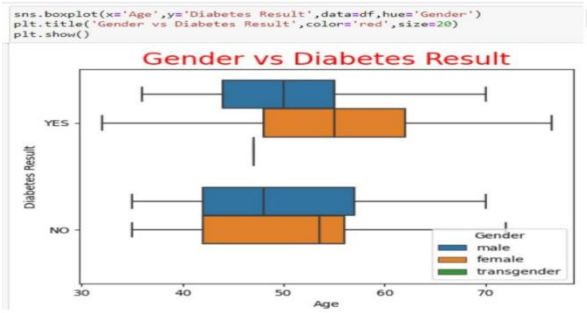
● Formula Fields for Efficiency:

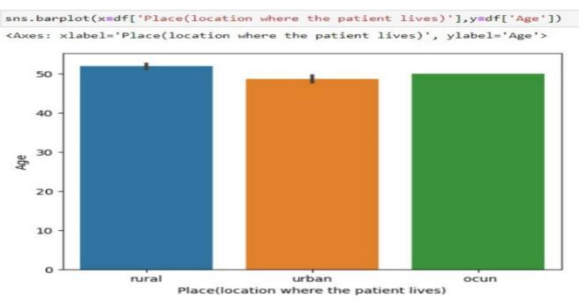
- **Derived Metrics:** Patient age, BMI, disease stage
- **Risk Score Calculations:** Based on weighted clinical indicators
- **Auto-Filled Fields:** Clinician name, patient ID, and follow-up schedules

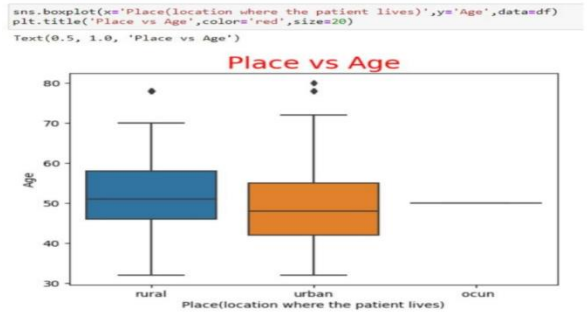
● UI & Navigation:

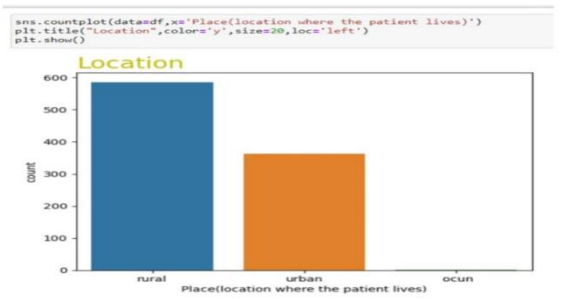
- **Liver Care Clinical App:** Intuitive web interface (Streamlit or Flask)
- **Navigation Tabs:** Easy access to Patients, Test Results, Risk Profiles, and Reports
- **Role-Based Views:** Custom pages for clinicians, lab technicians, and administrators

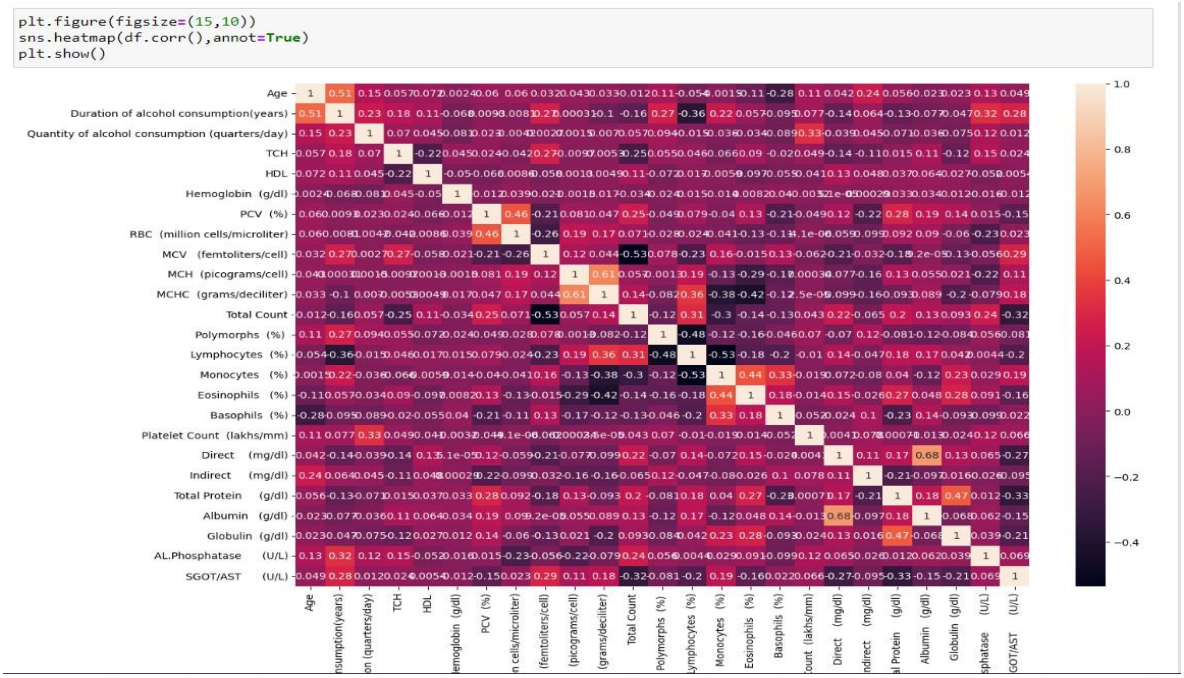
- **Reports and Dashboards:**
    - **Risk Summary Reports:** Patient-wise and population-level risk distributions
    - **Clinician Performance Reports:** Diagnosis timelines and intervention outcomes
    - **Liver Health Monitoring Dashboards:** Monthly patient trends, high-risk alerts, and disease progression tracking











🔹 Solution Architecture

Visualizing the Technical Structure and Clinical Data Relationships

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Object Relationship Overview:

Entity	Fields / Features
Patient Profile	Name, Category, Amenities, Address
Clinical Tests	Test Type (Liver Function, Imaging, Blood Markers), Results, Date
Risk Factors	Alcohol Use, Obesity, Hepatitis Status, Genetic History
Prediction Score	Risk Level (Low/Medium/High), Confidence Score, Predicted Disease Stage

Lookups & Data Relationships:

- **Clinical Tests** → Linked to **Patient Profile**
- **Risk Factors** → Linked to **Patient Profile**
- **Prediction Score** → Linked to **Patient Profile** and **Clinical Tests**

Formulas & Derived Fields:

- **BMI Calculation:** BMI = Weight (kg) / (Height (m))^2
- **Risk Score Formula:** Based on combined clinical indicators weighted by ML model
- **Patient Age:** Automatically calculated from Date of Birth
- **Follow-up Schedule:** Derived from risk score and last consultation date

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Automation:

- **Data Pipelines:** For real-time clinical data processing and cleaning
- **Machine Learning Models:** For automated liver cirrhosis risk prediction
- **Validation Logic:** Ensures all required test fields are filled and within valid clinical ranges
- **Dashboards & Reports:** For clinicians to view patient risk summaries, trends, and population health insights

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Summary

The **Project Design Phase** ensured that our liver cirrhosis prediction system:

- Accurately mapped **clinical data relationships**
- Included **real-time validation and automation** powered by advanced ML workflows
- Provided **intuitive user experiences** for clinicians through simplified navigation and role-based dashboards
- Followed **best practices in medical data management and system scalability**

This **technical blueprint** will guide the development, testing, and deployment phases, ensuring a reliable, predictive, and actionable solution for liver care.
