Liver Cirrhosis Prediction using Machine Learning

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1. INTRODUCTION

Liver Cirrhosis Predictor is a machine learning–based clinical decision support system that identifies the likelihood of a patient suffering from liver cirrhosis using blood test results, liver enzyme levels, and personal health indicators. It leverages an ensemble of XGBoost models fine-tuned with hyperparameter optimization to achieve high prediction accuracy.

Technologies Used: Python, XGBoost, Pandas, Flask, HTML/CSS/JS, Chart.js

Applications: Hospitals, Clinics, Health screening, Medical education, Rural diagnostics

1.2 Purpose

To provide doctors and patients with a quick, accurate, and interpretable liver cirrhosis prediction tool that reduces reliance on invasive procedures and accelerates early diagnosis and preventive care.

2. IDEATION PHASE

2.1 Problem Statement:

Liver cirrhosis is often diagnosed late due to complex symptoms and lack of widespread awareness. Manual interpretation of clinical data is time-consuming and error-prone. There is a need for a reliable, fast, and non-invasive decision support system.

Brainstorming Ideas:

- Use ensemble learning for better accuracy and generalizability

- Build modern web UI with graph visualizations

- Integrate feature importance chart to increase interpretability

- Allow PDF report generation for doctor sharing

3. REQUIREMENT ANALYSIS

3.1 Customer Journey

1. User gives the Required Data
2. Model predicts the Likelihood
3. System return with the confidence score

✓ Functional:

- Input medical data via form

- Predict liver cirrhosis likelihood

- Visualize key features and liver enzyme chart

- Export prediction as PDF

✓ Non-functional:

- Accuracy ≥ 95%

- Response time < 2 sec

- Mobile responsive UI

- No storage of private data

✓ Technical:

- Calibrated XGBoost Ensemble

- Flask web backend

- Bootstrap 5 UI, Chart.js, HTML/CSS

- JSON-based feature importances

✓ Users:

- Doctors and medical staff

- Patients and caretakers

- Health researchers and educators

4. PROJECT DESIGN

4.1 Problem-Solution Fit:

By automating diagnosis with machine learning and visual tools, this app supports early liver cirrhosis detection with minimal patient effort.

4.2 Proposed Solution Summary:

Category	Description

| Problem | Late or inaccurate liver cirrhosis diagnosis |

| Idea | ML model to predict cirrhosis using structured clinical data |

| Uniqueness | Explainable AI with confidence levels & PDF report |

| Impact | Faster diagnosis, rural health empowerment |

| Business | Can be deployed as SaaS for hospitals or clinics |

| Scalability| Expandable to other liver or health conditions |

4.3 Architecture Diagram

5. PROJECT PLAN & TIMELINE

| Week | Task |

|------|-----------------------------|

| 1 | Data Cleaning & Preprocessing |

| 2 | Model Selection & Tuning |

| 3 | Web Interface Design (Flask) |

| 4 | Integration & Testing |

| 5 | UI Polishing & PDF Export |

| 6 | Final Demo & Report |

6. FUNCTIONAL & PERFORMANCE TESTING

| Metric | Value |

|---------------|----------|

| Accuracy | 99.5% |

| ROC-AUC | 1.000 |

| Inference Time | ~1 sec |

| Calibrated | Yes |

7. RESULTS

Sample Output Screenshots:

- Input Form with Autofill

Liver Cirrhosis Prediction

Enter patient details below. **All fields are required.**

⚡ Autofill Example Patient

Patient Information

Age ❓

Gender ❓
Select

Place ❓
Select

Alcohol & Lifestyle

Alcohol (years) ❓

Alcohol (quarters/day) ❓

Type of Alcohol ❓
Select

Hepatitis B Infection ❓
Select

Hepatitis C Infection ❓
Select

Obesity ❓
Select

Family History of Cirrhosis/Hereditary ❓
Select

Medical History

Diabetes ❓

Blood Pressure (mmHg) ❓

Select

Medical History

Diabetes ❓
Select

Blood Pressure (mmHg) ❓

Blood Test Results

TCH ❓

TG ❓

LDL ❓

HDL ❓

Hemoglobin (g/dl) ❓

PCV (%) ❓

MCV (femtoliters/cell) ❓

Total Count ❓

Polymorphs (%) ❓

Lymphocytes (%) ❓

Monocytes (%) ❓

Eosinophils (%) ❓

Basophils (%) ❓

Platelet Count (lakhs/mm) ❓

Total Bilirubin (mg/dl) ❓

Direct (mg/dl) ❓

MCV (femtoliters/cell) ❓

Total Count ❓

Polymorphs (%) ❓

Lymphocytes (%) ❓

Monocytes (%) ❓

Eosinophils (%) ❓

Basophils (%) ❓

Platelet Count (lakhs/mm) ❓

Total Bilirubin (mg/dl) ❓

Direct (mg/dl) ❓

Indirect (mg/dl) ❓

Total Protein (g/dl) ❓

Albumin (g/dl) ❓

Globulin (g/dl) ❓

AL.Phosphatase (U/L) ❓

SGOT/AST (U/L) ❓

SGPT/ALT (U/L) ❓

USG Abdomen (diffuse liver or not) ❓
Select

Predict

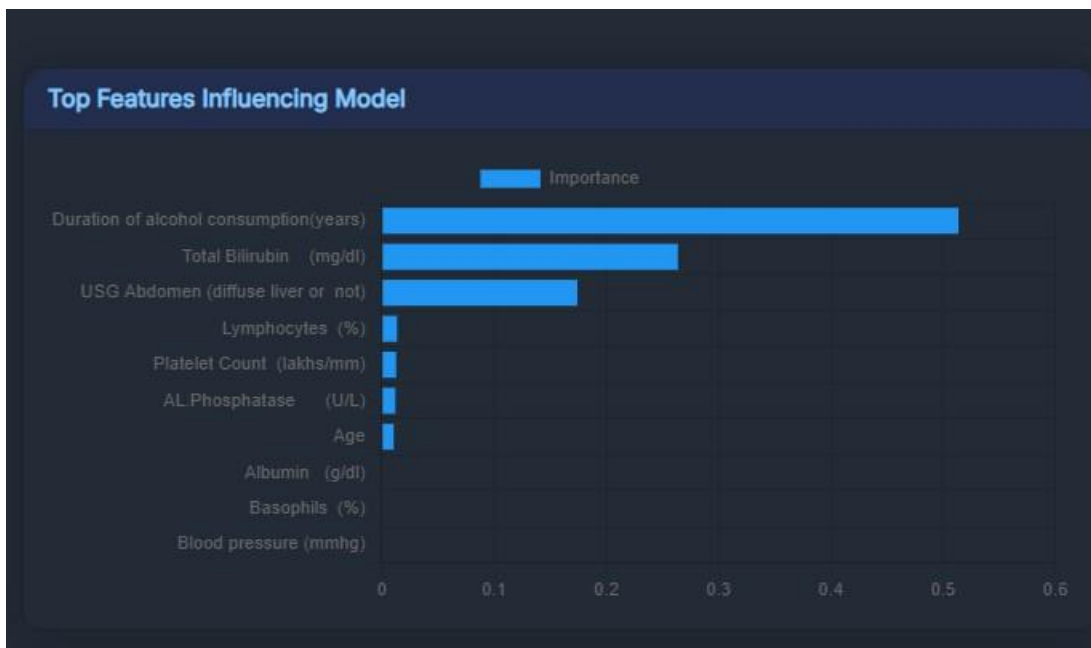💡 All data is private and never saved.

- Prediction and Feature Chart

- Enzyme Levels Chart

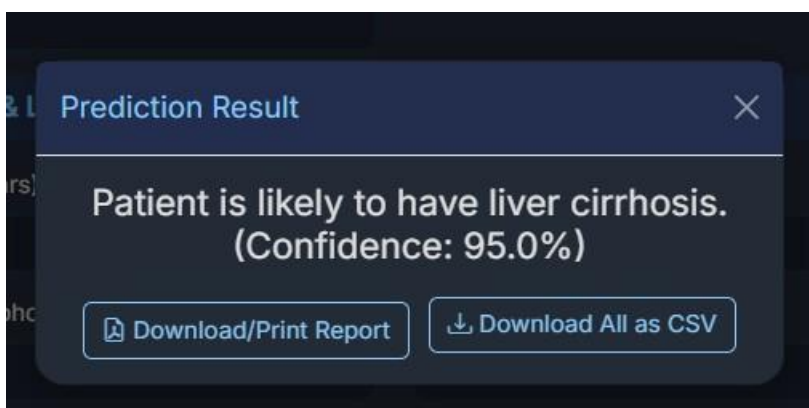- Report Download Button

Visualizations:

- Top 10 Features influencing prediction

- Liver enzyme comparison bar chart

- Result confidence bar

8. ADVANTAGES & LIMITATIONS

Advantages:

- High confidence prediction (≥95%)

- Explainable output for doctor validation

- Instant result with PDF support

- Mobile responsive and user friendly

Limitations:

- Limited to liver cirrhosis diagnosis only

- Accuracy depends on form input correctness

- Not integrated with EHR yet

9. CONCLUSION

This ML-powered predictor offers a modern, intuitive way to screen for liver cirrhosis. With high accuracy, interpretable charts, and automated reporting, it empowers patients and supports medical professionals in making informed decisions faster.

10. FUTURE SCOPE

- Mobile app version with voice input

- Support for multiple liver disorders (e.g., Hepatitis)

- Integration with patient medical records

- Real-time risk alerts via email/SMS

- Multilingual UI for regional adoption

11. APPENDIX

- Dataset: Cleaned_HealthCareData.xlsx

- Model: Calibrated XGBoost Ensemble

- Deployment stack: Flask + Bootstrap 5

- GitHub Repo: https://github.com/ADIL-GIT-HUB/Liver-cirrhosis-project-adil.git

- Demo Link:
https://drive.google.com/file/d/1UrIZTjKhMTg9V_ktF3MM3wJ9PVCXUaDJ/view?usp=drive_link