**Project Report**

**PROJECT**

**Project Title:**

**Revolutionizing Liver Care: Predicting Liver Cirrhosis Using Advanced Machine Learning Techniques**

**Team Name:**

Team bhumika

**Team Members:**

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**Phase-1: Brainstorming & Ideation**

**Objective:**

To develop an AI-powered system for early prediction of liver cirrhosis using machine learning algorithms that assists healthcare professionals by enhancing diagnostic accuracy, reducing time to diagnosis, and enabling preventive liver care.

**Key Points:**

**1. Problem Statement:**

* Liver cirrhosis, a chronic liver disease, often progresses silently and is diagnosed at advanced stages, limiting treatment effectiveness.
* Traditional diagnostic approaches like liver biopsy are invasive, time-consuming, and require expert interpretation.
* This project aims to automate cirrhosis prediction based on clinical features using machine learning models, enabling earlier and more accessible diagnosis.

**2. Proposed Solution:**

* A machine learning-based system that analyzes patient data (e.g., bilirubin, albumin, INR, enzyme levels) and predicts the likelihood of cirrhosis.
* Integrates classification models such as Random Forest, Support Vector Machine, Logistic Regression, and Decision Tree for accurate prediction.

**3. Target Users:**

* Healthcare providers (doctors, liver specialists) for diagnostic support.
* Hospitals and screening centers for mass liver health analysis.
* Telemedicine platforms for remote monitoring and prediction.
* Health researchers analyzing liver disease progression.

**4. Expected Outcome:**

* A deployable ML application capable of predicting liver cirrhosis risk using clinical data.
* Enhanced decision-making for early treatment and management.
* Reduction in dependency on invasive diagnostic procedures.

**Phase-2: Requirement Analysis**

**Objective:**

To define the functional and technical requirements necessary for building the liver cirrhosis prediction system.

**Key Points:**

**1. Technical Requirements:**

* **Programming Language:** Python
* **Libraries:** Pandas, NumPy, Scikit-learn, Seaborn, Matplotlib, Flask
* **ML Algorithms:** Logistic Regression, SVM, Decision Tree, Random Forest
* **IDE:** Jupyter Notebook / VS Code
* **Deployment:** Flask web app

**2. Functional Requirements:**

* Upload or enter patient clinical details (dataset features).
* Predict liver cirrhosis status (Yes/No) and risk score.
* Visualize model accuracy and prediction results.
* User-friendly interface for medical staff and researchers.

**3. Constraints & Challenges:**

* Handling missing or noisy data in medical records.
* Avoiding bias due to class imbalance in datasets.
* Ensuring high precision to prevent false diagnoses.
* Designing an intuitive frontend for non-technical users.

**Phase-3: Project Design**

**Objective:**

To define the system architecture and design user interaction flow.

**Key Points:**

**1. System Architecture:**

* Patient data is input via the web interface.
* Backend processes the data using trained machine learning models.
* Prediction output is returned to the UI along with a confidence score.
* The models are trained on UCI Liver Cirrhosis dataset and validated through test data.

**2. User Flow:**

1. User accesses web application.
2. Inputs or uploads patient details.
3. Model processes data and predicts cirrhosis risk.
4. Displays result and recommendation.
5. Option to analyze additional patients.

**Phase-4: Project Planning**

**Objective:**

Plan and distribute development tasks for timely and efficient project completion.

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| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Task** | **Priority** | **Duration** | **Assigned To** | **Dependencies** | **Expected Outcome** |
| Sprint 1 | Environment Setup & Data Preprocessing | 🔴 High | 3 hrs | Member 1 | Python, Pandas | Cleaned dataset |
| Sprint 1 | Exploratory Data Analysis | 🔴 High | 2 hrs | Member 2 | Dataset ready | Insightful plots |
| Sprint 2 | Model Training (LR, SVM, RF, DT) | 🔴 High | 5 hrs | Member 3 | Preprocessed data | Trained models |
| Sprint 2 | Flask Web Integration | 🟡 Medium | 3 hrs | Member 4 | Trained model | Working web app |
| Sprint 3 | UI Testing & Optimization | 🟡 Medium | 2 hrs | Member 2 & 3 | Web app ready | Responsive UI |
| Sprint 3 | Deployment & Presentation | 🟢 Low | 1 hr | Team | Completed system | Ready for demo |

**Phase-5: Project Development**

**Objective:**

Implement liver cirrhosis prediction models and web interface.

**Key Points:**

**1. Technology Stack:**

* **Frontend:** HTML/CSS via Flask templates
* **Backend:** Flask (Python)
* **ML Models:** Logistic Regression, SVM, Decision Tree, Random Forest
* **Data:** UCI Liver Cirrhosis Dataset
* **Visualization:** Seaborn, Matplotlib

**2. Development Process:**

* Performed data cleaning and feature engineering.
* Trained and validated multiple classification models.
* Chose best-performing model based on accuracy and F1-score.
* Integrated model into Flask web app.
* Designed a clean interface for prediction and risk display.

**3. Challenges & Fixes:**

* **Class imbalance** — Solved using stratified sampling and SMOTE.
* **Overfitting** — Handled using pruning in trees and regularization.
* **Data quality issues** — Resolved by imputing missing values.
* **UI glitches** — Fixed by responsive design and CSS tuning.

**Phase-6: Functional & Performance**

**Objective:**

Ensure robust and accurate functioning of the system through testing.

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| --- | --- | --- | --- | --- | --- |
| **Test ID** | **Category** | **Scenario** | **Expected Outcome** | **Status** | **Tester** |
| TC-001 | Functional | Normal liver input | Predicts "No Cirrhosis" | ✅ Passed | Tester 1 |
| TC-002 | Functional | Cirrhosis data input | Predicts "Cirrhosis" | ✅ Passed | Tester 2 |
| TC-003 | Performance | Bulk input test | All processed in < 3s | ⚠ Slight Delay | Tester 3 |
| TC-004 | UI | Mobile layout test | Fully responsive | ✅ Passed | Tester 2 |
| TC-005 | Deployment | Live demo test | Model predicts online | 🚀 Deployed | DevOps |

**Conclusion:**

The project *“Revolutionizing Liver Care: Predicting Liver Cirrhosis using Advanced Machine Learning Techniques”* successfully demonstrates the potential of machine learning in healthcare diagnostics. The implemented system aids in early detection of cirrhosis using clinical data, offering speed, reliability, and accessibility. With further improvements, this project can be expanded into a large-scale liver screening tool, benefiting hospitals and healthcare providers globally.