TEAM BACK TO LAYS

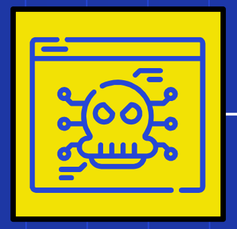
Password Strength Analyzer with AI, ML, HIBP and Hashcat

Intelligent Tool for Password Strength Analysis using GenAI, Machine Learning and Hashcat

HACK-O-HIRE-2025

TEAM - Back to Lays

Aditi Roy



Aditya Verma

Sahil Adhikari

Ayush Mukherjee

UNDERSTANDING THE PROBLEM STATEMENT

Problem Statement:

- Weak passwords are a major vulnerability, leading to frequent security breaches.
- Existing strength meters often lack in-depth analysis and actionable insights.
- There is a need for an intelligent tool that not only evaluates password strength but also explains weaknesses and suggests improvements smartly—all while keeping user data private (local processing & hashing).

Objective:

- Develop an intelligent web based AI tool to analyze password strength using ML for analysis (RockYou 2009&2024), realtime HIBP Lookup and pre-trained GEN-AI models
- Estimate time-to-crack using bcrypt and hashcat, check against breach databases, and provide interpretable feedback with strong alternative suggestions.

OUR SOLUTION

With over 80% of breaches linked to weak passwords, securing this vulnerability is critical. Our tool addresses this head-on..

Phase 1 - Requirement Analysis

Objective:

- Identify security gaps in current password strength evaluations.
- Analyze the RockYou and HIBP dataset and leaked password trends.

Define key features:

- GenAI-based password suggestions.
- Machine Learning Pattern Analysis
- Time-to-crack estimation.
- Vulnerability feedback.

Stakeholders:

- Barclays / Enterprise Cybersecurity Team
- End Users (Employees, Customers)
- Regulatory Bodies

Phase 2 - System Design

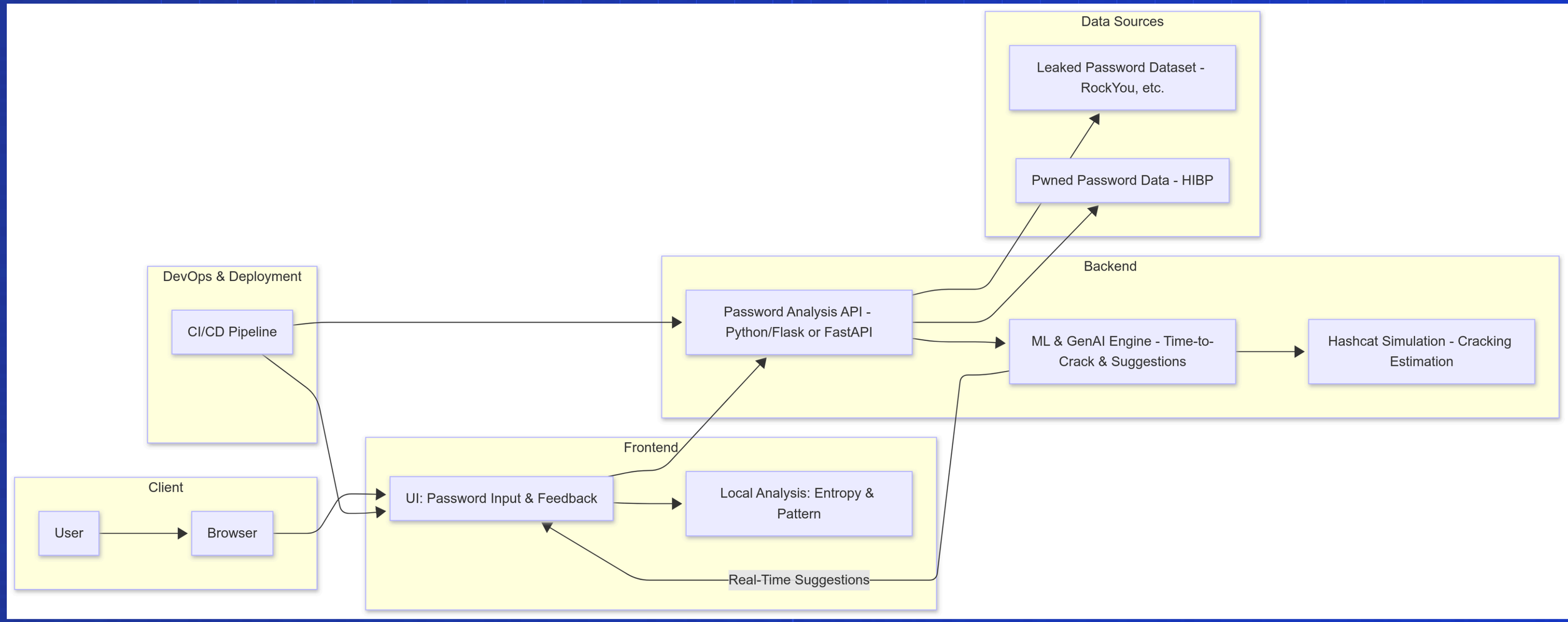
Architectural Considerations:

- Frontend: Vite/React for a responsive modular user interface.
- Backend: Efficient FastAPI framework for low-latency, high-performance password analysis and security evaluation.
    - **ML & AI:**
        - GenAI (OLLAMA LLM) for generating human-readable explanations and suggestions.
        - Trained on RockYou LightGBM Classifier – A gradient boosting model
    - **Security Analysis:**
        - Hashcat for password cracking simulation.
        - Entropy-based evaluation for detailed strength metrics.
        - For security and user data saftey model will be processing locally(user device)
        - Live lookup on HIBP Database

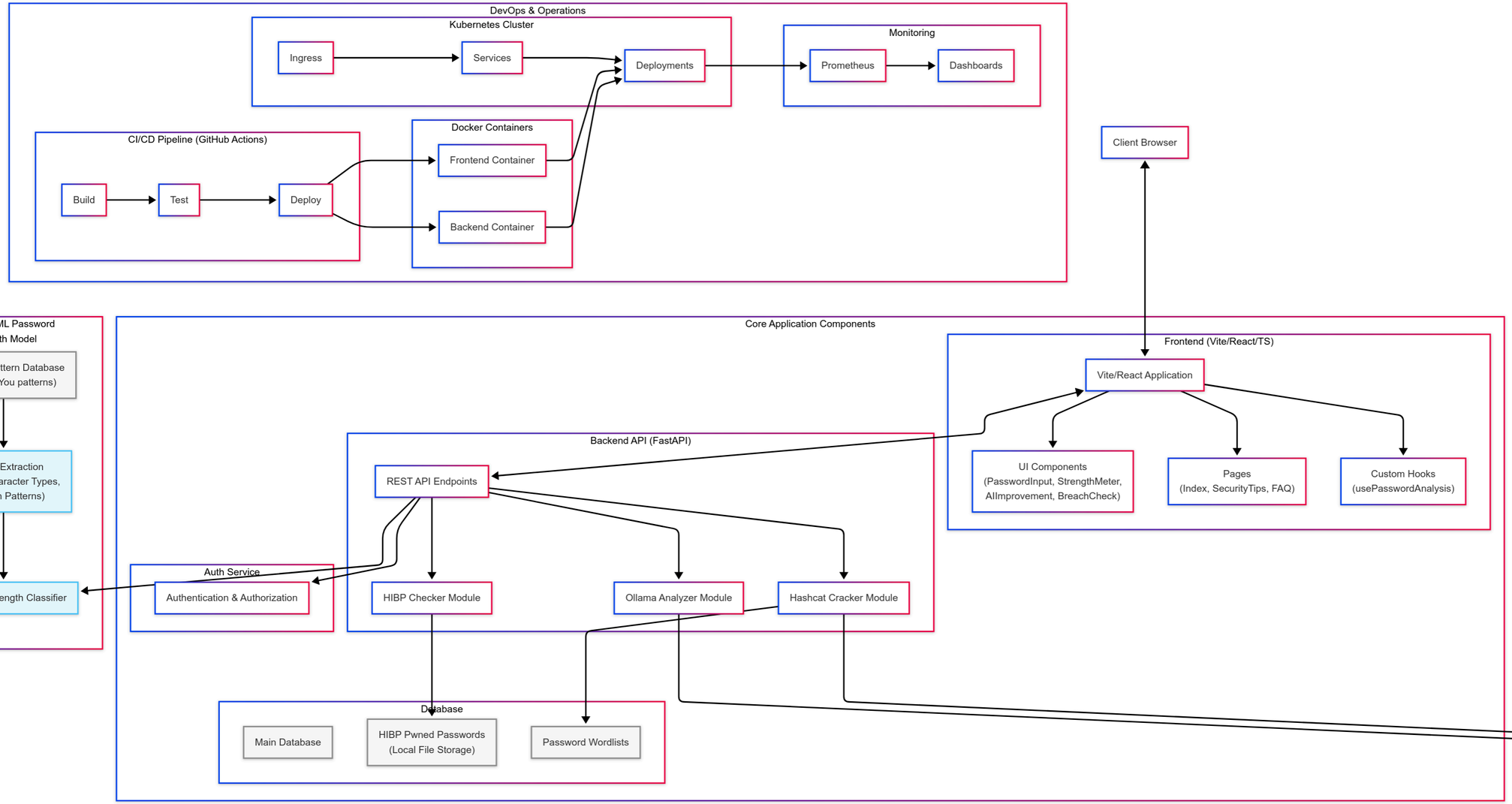
High-Level System Architecture (Diagram):

UI ➡ Backend API ➡ ML Model ➡ HIBP lookup and Hashcat result ➡ GenAI model ➡ Feedback to User.

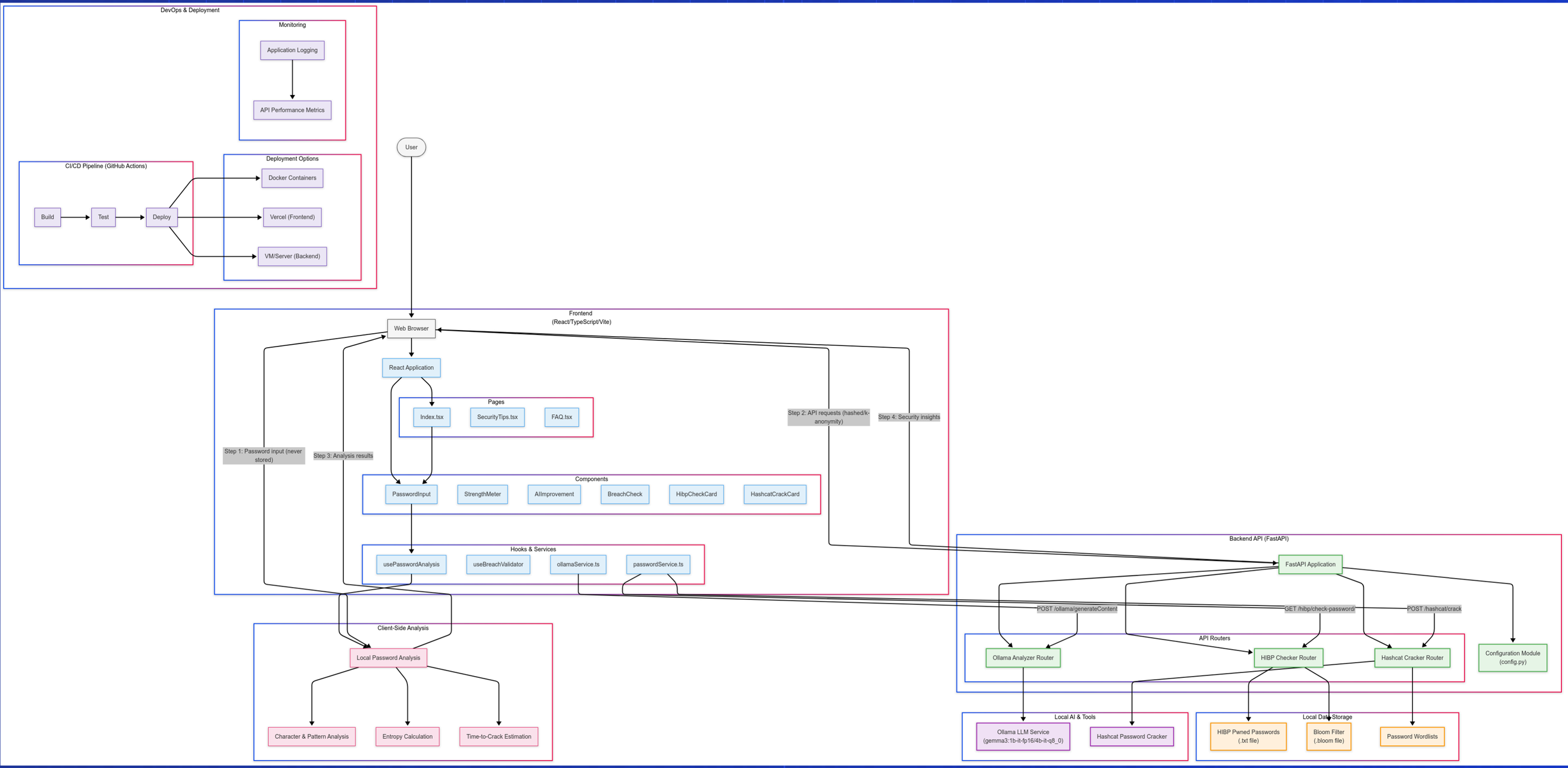
HIGH LEVEL WORKFLOW DIAGRAM



WORKFLOW DIAGRAM



DETAILED WORKFLOW DIAGRAM



Phase 3 - Implementation

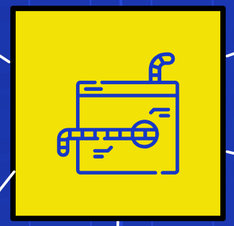
Sprint-Based Development Approach:

Sprint 1
Data Collection & Preprocessing

Gather RockYou dataset and analyze password patterns.

Sprint 2
Model Development

Train ML models on password vulnerabilities, HIBP lookup and hashcat program



Sprint 3
GenAI Integration

Integrate GenAI to generate explanations and suggest enhancements.

Sprint 4
Web UI & API Development

Build a clean, interactive frontend that calls the /analyze endpoint.

Sprint 5
Security Enhancements & Optimization

Implement additional safeguards, optimize performance, and refine calculations.

Phase 4 - Testing

Types of Testing Used:

1

Unit Testing

Validate password strength evaluation and hashing algorithm efficiency.

2

Integration Testing:

Ensure smooth communication between the ML model,GenAI LLM,Hashcat and HIBP service API, and UI.

3

Security Testing:

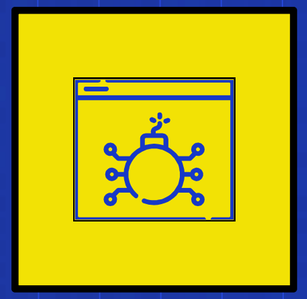
Simulate attacks (brute-force, dictionary-based) using Hashcat. [MD5 & SHA256]

4

User Testing

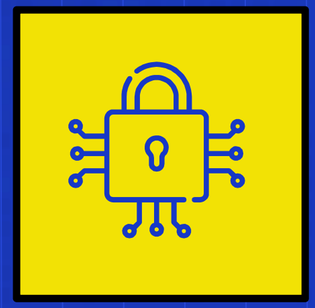
Gather feedback on usability and clarity of explanations.

Phase 5 - Deployment & Maintenance



Deployment Strategy

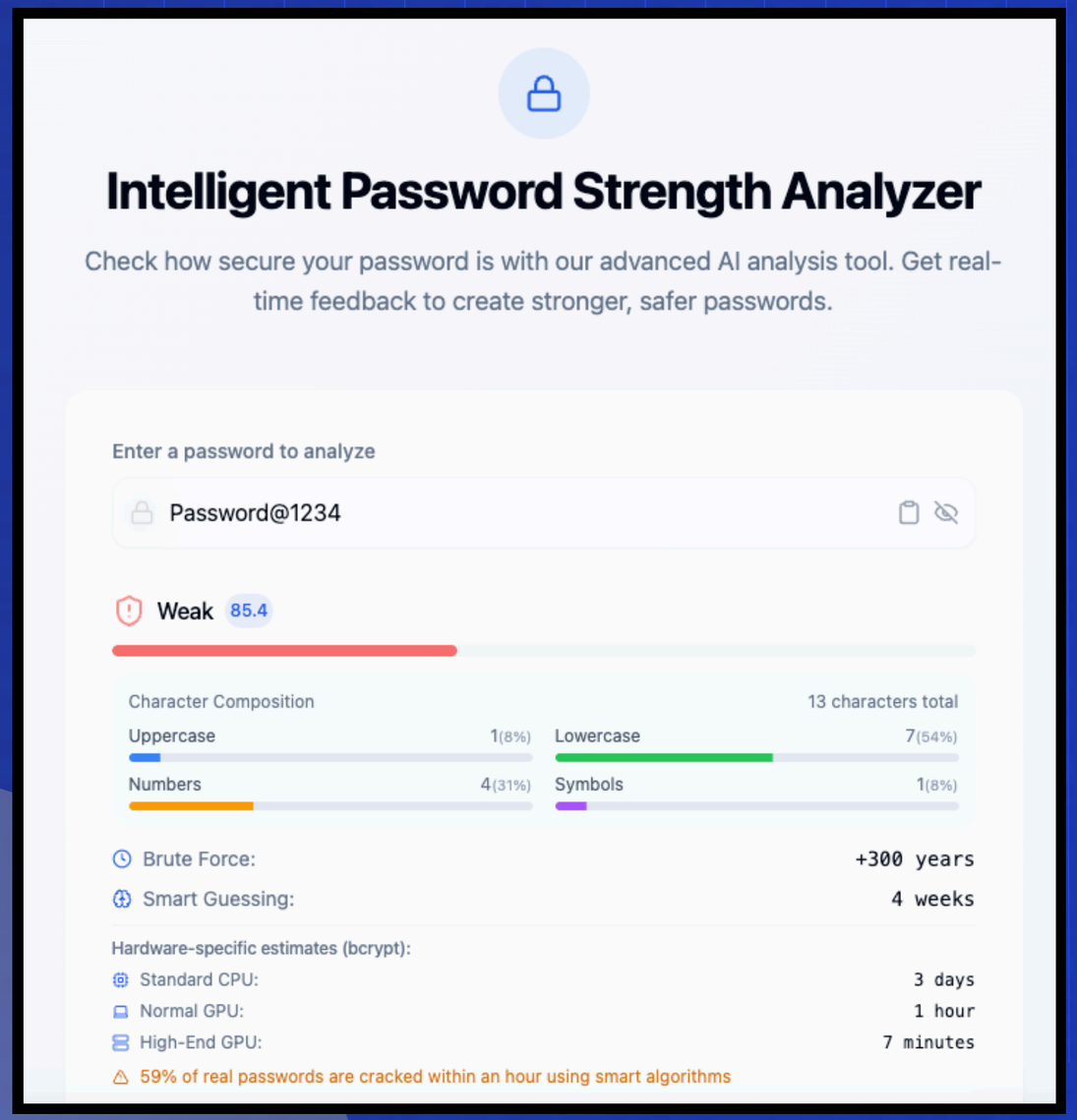
- CI/CD Pipeline: Automate deployments using GitHub Actions or Jenkins.
- Cloud Deployment: Host on AWS/GCP for scalability.
- Prometheus and Grafana for API monitoring
- Docker and Kubernetes



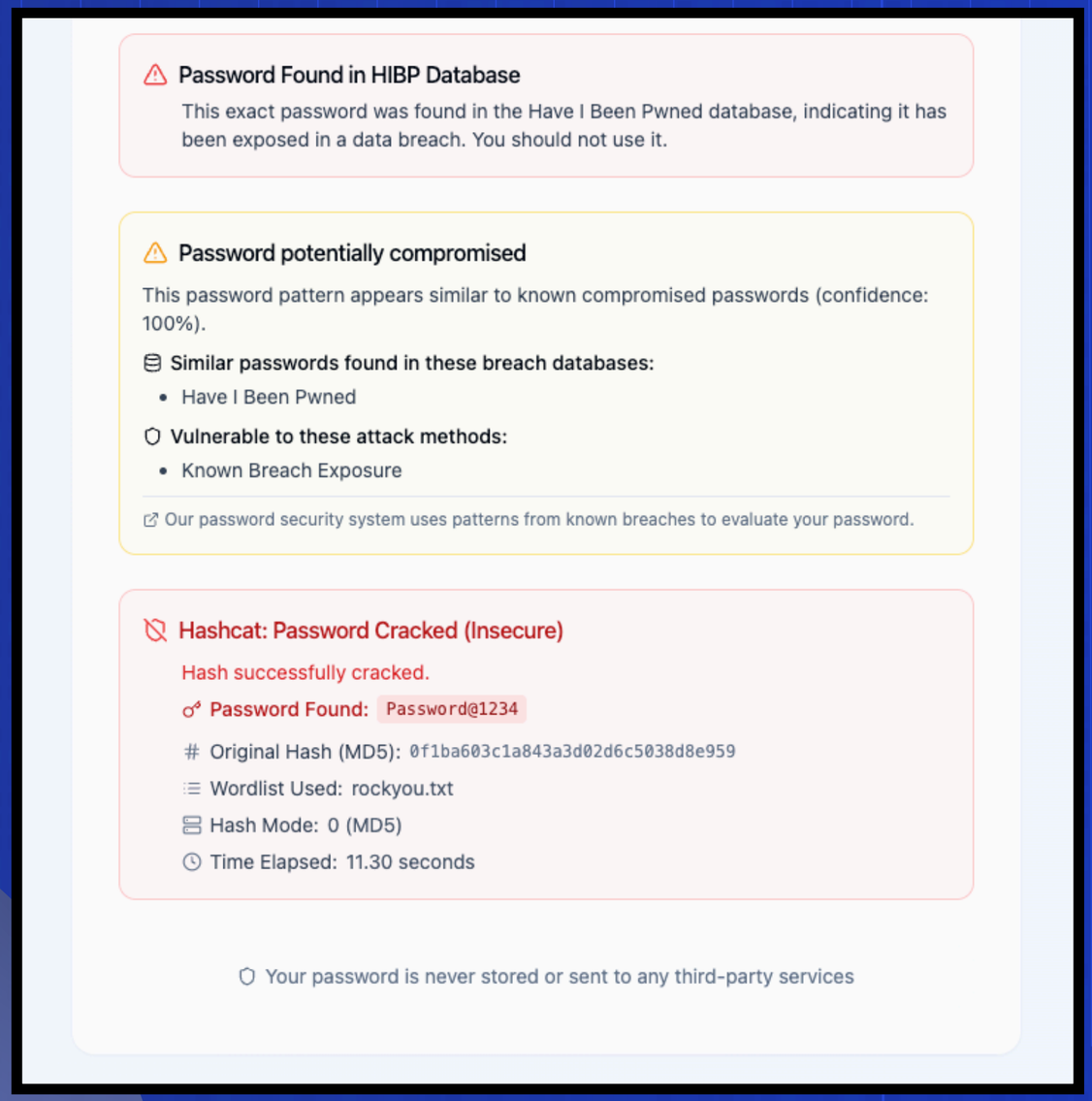
Maintenance Approach

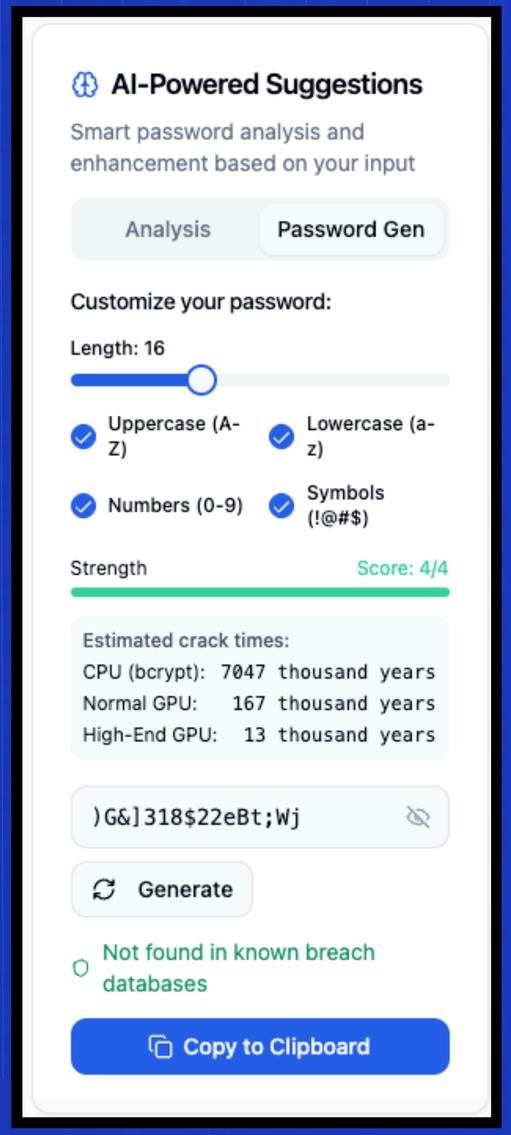
- Regular Updates: Continuously update ML models and HIBP with new versions.
- Logging & Monitoring: Detect anomalies such as frequent weak passwords.
- User Feedback Loop: Refine UI and AI suggestions based on user interactions.

Output UI Design Result



Output UI Design Result





Benefits

Enhanced Security:

Significantly reduces the risk of password-related breaches by not only on character composition but also realtime lookup with GenAI

Real-time Feedback

Provides immediate, actionable insights for stronger passwords.

Compliance & Risk Mitigation

Helps meet cybersecurity policies and regulatory standards.

Future Scope

Multilingual Support

Enable analysis of passwords in various languages, accommodating diverse character sets and linguistic patterns. Research indicates that multilingual passphrases can significantly increase password strength by expanding the character set and disrupting predictable patterns.

Enterprise Integration

Facilitate seamless integration with enterprise systems, such as Single Sign-On (SSO) and Identity and Access Management (IAM) solutions. This will allow organizations to enforce password policies consistently across their infrastructure, enhancing security and compliance.

Enhanced User Interaction & Personalized Guidance

GenAI to act as an adaptive coach, offering specific, context-aware transformations tailored to identified weaknesses. We also plan to introduce novel structural visualizations that intuitively highlighting the weakest links for better user understanding and exploring privacy-aware gamification elements and feedback on common weak patterns making the tool a proactive partner in improving long-term security hygiene.

Conclusion

- SDLC-driven approach incorporating ML and GenAI to enhance password security

- Iterative phases from requirement analysis to deployment, with a strong emphasis on privacy and robust testing