Tribhuvan University

Faculty of Humanities and Social Science

A PROJECT REPORT ON

FraudShield System

Submitted to

Department of Computer Application

Nepal Mega College

In partial fulfillment of the requirements for the Bachelors in Computer Application

Submitted by

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June, 2025

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SUPERVISOR'S RECOMMENDATION

I hereby recommend that this project prepared under my supervision by "**Bijay Koirala**" and "**Kaushal Joshi**", entitled "**FraudShield**" in partial fulfillment of the requirements for the degree of Bachelor of Computer Applications is recommended for the final evaluation.

Signature of the Supervisor

Basanta Chapagain

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LETTER OF APPROVAL

This is to certify that this project prepared by, "**Bijay Koirala**" and "**Kaushal Joshi**" entitled "**FraudShield**" in partial fulfillment of the requirements for the degree of Bachelor in Computer Applicationhas been evaluated. In our opinion it is satisfactory in the scope and quality as a project for the required degree.

…… Basanta Chapagain Supervisor Babarmahal, Kathmandu	---------- Dharma Raj Poudel Coordinator Babarmahal, Kathmandu
---------- Internal Examiner	---------- External Examiner

ABSTRACT

FraudShield is a fraud detection system developed for small online stores to identify suspicious transactions. Instead of using complex machine learning, the system use straightforward rule-based approach that checks for common red flags. The system analyzes transaction details including email addresses, IP addresses, and card information, looking for warning signs such as disposable email accounts (like 10minutemail), suspicious IP addresses, or the same card being used with multiple different emails. When a purchase is made, the system quickly evaluates these patterns and assigns a fraud score. FraudShield's key feature is transparency - when flagging a transaction, it provides exact reasons, such as temporary email service usage or cards seen in multiple locations. Store owners can view these explanations and make informed decisions about order acceptance or review. Built using Python for the backend, MongoDB for the database, and JavaScript for the web interface, the system runs locally or on a simple server. While unable to detect sophisticated fraud using advanced techniques, FraudShield effectively prevents obvious fraud attempts commonly faced by small businesses. Though not 100% accurate, but it serves as a practical first line of defense that is easy to understand and implement.

Keywords: FraudShield, Fraud detection, Rule-based system, E-commerce security

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to everyone who supported and contributed to the development of the FraudShield project. First and foremost, we would like to thank our teachers and mentors for their invaluable guidance and encouragement throughout this project. We are also deeply grateful to our supervisor for their continuous support and direction. Your expertise and feedback helped steer this project towards success. Lastly, we would like to acknowledge the online communities and resources that provided the technical knowledge and inspiration necessary for this project. Its contributions to the broader field of educational technology are deeply appreciated. Thank you all for your support and encouragement. This project would not have been possible without you.

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LIST OF ABBREVIATIONS

API – Application Programming Interface

BCA: Bachelor of Computer Applications

CSS: Cascading Style Sheets

DBMS – Database Management System

HTML: Hypertext Markup Language

IP – Internet Protocol

JS – JavaScript

ML – Machine Learning

VPN – Virtual Private Network

CHAPTER 1:

INTRODUCTION

1.1 Introduction

FraudShield is a real-time fraud detection system designed to help small online sellers to identify and prevent suspicious transactions. In today's digital commerce landscape, online fraud has become a significant challenge for businesses of all sizes, with fraudulent transactions costing merchants billions annually. Small and medium-sized businesses are particularly vulnerable as they often lack the resources to implement modern fraud prevention systems.

This project addresses this gap by providing an accessible, transparent fraud detection solution. FraudShield analyzes transaction and user behavior patterns to provide a fraud score, decision, and clear explanation for each case. Unlike black-box machine learning systems, it uses rule-based detection that merchants can understand and trust. The system checks for common fraud indicators such as disposable email addresses, suspicious IP addresses, unusual transaction patterns, and card reuse across multiple accounts.

The system emphasizes three core principles: speed, transparency, and easy integration. Transactions are analyzed in real-time, typically within milli or seconds, allowing merchants to make immediate decisions. Each fraud decision comes with detailed reasoning, explaining which rules were triggered and why. Integration is simplified through a lightweight JavaScript snippet that can be added to any checkout page.

Built using Python Flask for the backend API, MongoDB for data storage, and vanilla JavaScript for the frontend, FraudShield operates as a practical solution for businesses seeking basic fraud protection. This report outlines the project's objectives, system architecture, implementation process, testing results, and future development possibilities.

1.2. Problem Statement:

In today’s online world, fraud isn’t just a technical issue — it’s a daily headache for small and medium-sized businesses. Imagine a seller wakes up to see that someone used a fake identity, a stolen credit card, or a VPN to place a high-value order — only for the payment to later fail or get disputed. By the time the seller realizes, the damage is done.

Most fraud detection tools out there are either too expensive, too complex, or act like a black box — you don't know why a transaction was flagged.

FraudShield aims to solve this by offering a fast, transparent, and easy-to-integrate fraud detection system. It helps store owners catch shady transactions before they cause harm, and shows exactly why a transaction is marked suspicious — no guesswork, no mystery.

1.3. Objectives:

FraudShield is a stateless, real-time fraud detection platform for online sellers. It is designed to:

- To implement a fraud detection system that provides risk scores based on predefined security rules and delivers transaction decisions within acceptable response time.

1.4. Scope and Limitation

1.4.1. Scope

This project focuses on building a lightweight, rule-based fraud detection system designed for small to medium-sized online stores. The system analyses basic transaction and user behaviour data to detect fraud patterns such as VPN usage, price tampering, and reused cards.

It includes:

- A backend engine for fraud scoring and decision making
- A ruleset that explains why a transaction is flagged
- Integration through a JavaScript snippet for real-time use
- Testing with simulated fraud scenarios

The project does not cover machine learning, or payment processing on real e-commerce platforms.

1.4.2 Limitations

While FraudShield is designed to be effective and practical, it has the following limitations:

- The system relies on predefined rules, which may miss new or evolving fraud techniques.

- Detection accuracy depends on the quality of input data; incomplete or fake data may reduce effectiveness.
- It requires transaction and user data from the checkout page or e-commerce site to function, which may not always be available.
- No support for machine learning or adaptive behavior in this version.

1.5. Development Methodology

The Iterative Waterfall Model is a hybrid software development lifecycle (SDLC) approach that combines the structured, sequential phases of the traditional Waterfall Model with iterative elements to allow for flexibility and incremental improvements.

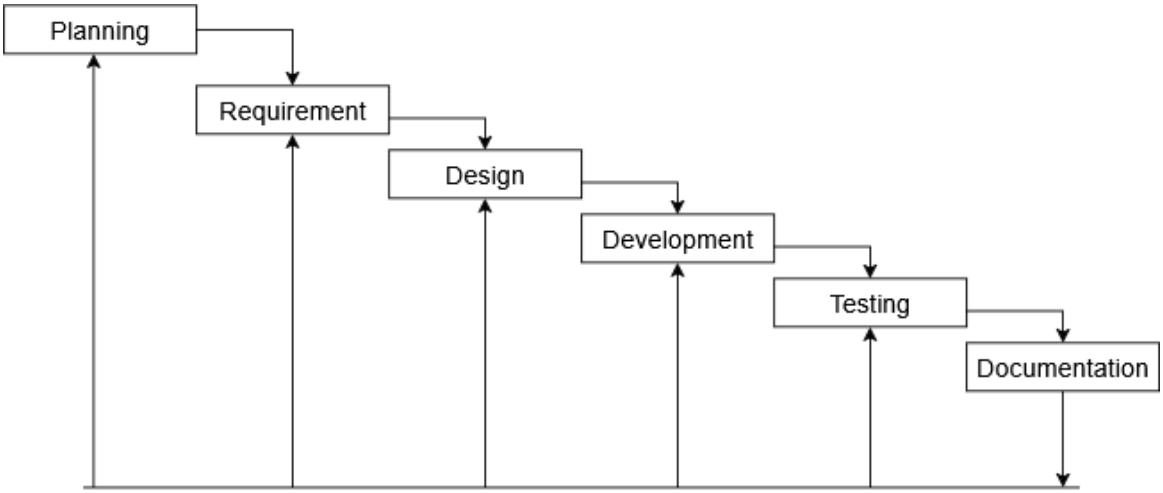


Figure 1: Iterative Waterfall Model of FraudShield

1.6. Report Organization

Chapter 1: Provides an overview of online fraud challenges in e-commerce and introduces FraudShield as a rule-based solution. Defines project objectives, establishes the scope of fraud detection capabilities, and acknowledges system limitations.

Chapter 2: Examines existing fraud detection approaches, comparing rule-based systems with machine learning solutions. Reviews current fraud patterns in e-commerce and analyzes gaps in affordable fraud prevention for small businesses.

Chapter 3: Presents the technical architecture including Flask API design, MongoDB database schema, and fraud scoring algorithm. Details the implementation of core modules: authentication system, rule engine, bulk processing, and admin dashboard.

Chapter 4: Documents unit testing of individual components, integration testing of the complete system, and performance benchmarks. Presents fraud detection accuracy results using sample transaction datasets.

Chapter 5: Summarizes project achievements against stated objectives, discusses practical applications for small businesses, and identifies areas for enhancement including machine learning integration and real-time pattern updates.

CHAPTER 2:
BACKGROUND STUDY AND LITERATURE REVIEW

2.1. Background Study

Fraud detection refers to identifying abnormal or malicious behaviour during online transactions. In e-commerce, fraud can appear in many forms — from stolen payment details to fake identities or automated bots exploiting the checkout process.

This project uses a rule-based detection model, where specific rules are written to flag known suspicious behaviours. It avoids machine learning and instead provides clear, logic-driven decisions with reasons.

Key concepts and terminologies involved include:

- **VPN/Proxy Detection** – used to mask real user location, often a red flag
- **Temporary Email Identification** – spotting disposable or one-time emails often used in scams
- **Fake Address Detection** – checking for mismatched or unverifiable billing/shipping addresses
- **Card BIN Analysis** – verifying card origin, type, and legitimacy using the BIN number
- **Device Fingerprinting** – tracking repeated use of the same device in multiple transactions
- **Fast Checkout Behaviour** – identifying bots or scripts based on abnormal speed
- **IP and Geo-Location Check** – ensuring the IP address aligns with the expected country or region

These elements are processed in real time using backend logic, supported by MongoDB, and triggered via a JavaScript snippet embedded on checkout pages.

2.2. Literature Review

Fraud detection in online transactions has been the focus of various research studies, primarily cantered around machine learning techniques. Mitchell et al. pro [1]posed a neural network-based model for real-time credit card fraud detection, demonstrating strong accuracy in classifying suspicious transactions. However, their approach required large amounts of labelled data and lacked transparency in how decisions were made, making it less practical for small to mid-sized businesses. Similarly, Mendez and Stein in [2]

introduced an ensemble model combining multiple ML algorithms, which improved detection rates but significantly increased system complexity and computational overhead.

In contrast, Müller and Park [3] explored a rule-based method to evaluate browser behaviour and detect fraud at the frontend level. While their approach was simpler and more interpretable than ML models, it lacked real-time responsiveness and was not designed for direct integration into active e-commerce checkout flows. Most publicly available tools, such as CC checkers or black-box APIs, also fall short in terms of explanation, customization, and real-time usability.

From the reviewed literature, it is evident that there is a gap in the availability of lightweight, explainable fraud detection systems tailored for small businesses. Existing models are either too complex to implement without technical expertise or too opaque to trust in high-risk environments. This highlights the need for a system that is not only easy to integrate but also capable of providing fraud decisions with clear reasoning in real time.

FraudShield addresses this gap by offering a rule-based, transparent fraud detection solution that works instantly at the point of transaction. Unlike existing systems, it does not rely on machine learning or massive datasets, making it more accessible, explainable, and practical for businesses with limited resources.

2.2.1 Review of similar system

Ahmed et al.'s Ontology-Based Fraud Detection System (2021) [4]**:**

This system uses a set of predefined rules linked to a knowledge base to spot unusual financial activities. It can rate the seriousness of suspicious transactions, which makes it easy to understand, but the setup process is complex and not ideal for smaller organizations.

Automated Rules Management System (ARMS, 2020) [5]**:**

ARMS improves human-written rules by removing unnecessary ones and re-ordering the rest so they work more efficiently. This reduces false alarms while keeping the system accurate, though it still depends heavily on manual rule creation.

CHAPTER 3:

SYSTEM ANALYSIS AND DESIGN

3.1. System Analysis

3.1.1. Requirement Analysis

Requirement analysis is a critical step in determining the success of a system or software project. It involves identifying and documenting the essential needs and expectations that the project must fulfill during its development. These requirements serve as the foundation for designing and implementing the system effectively.

i. Functional Requirements

These are the requirements that the end user specifically demands as basic facilities that the system should offer.

Fraud Check API Input Data:

```
{
  "email": string,          // user@example.com
  "ip": string,             // 192.168.1.1
  "card_number": string,    // 4111111111111111
  "price": number,          // 99.99
  "fingerprint": string     // device_id_12345
}
```

What happens with wrong data:

- Missing email → Fraud score: 0, can't check disposable domains

- Invalid IP → Fraud score: +0.2, treated as suspicious

- Card number too short → Can't check BIN, skips card checks

- Price as string → Converts to float or returns error

- Missing fingerprint → Can't check device reuse

Functional requirements can be represented in use case diagram.

Use Case Diagram

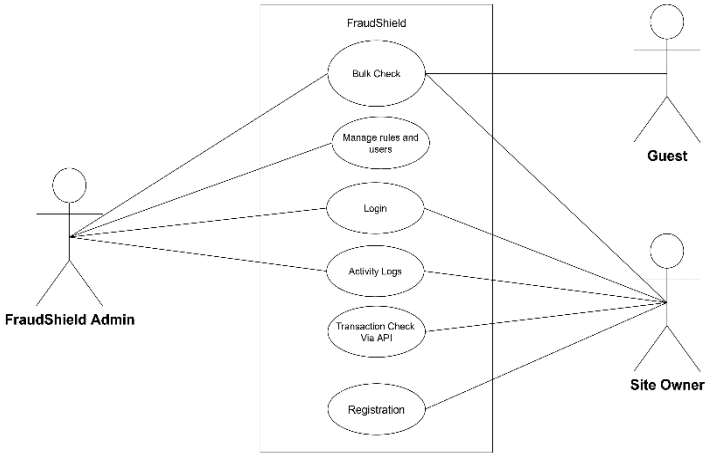


Figure 2: Use Case Diagram

ii. Non-functional Requirements

These are the quality constraints that the system must meet, often referred to as non-functional requirements. They do not describe specific behaviors or functions of the system core functionality.

- API must respond within 500ms (Available in test).
- System should handle multiple requests at once.
- Same input should always give same result (Available in test).
- Only authorized users can access admin panel and logs.
- Rules and backend should be easy to update.

3.1.2. Feasibility Study

Feasibility refers to the practicality or possibility of a proposed plan, project, or system being successful and effective. Following feasibilities were studied while building the system to ensure the system be built with exact requirements in specified time.

3.1.2.1. Technical Feasibility

The system is technically feasible using JavaScript, Python, and MongoDB. All required tools and technologies are open-source and already tested during development.

3.1.2.2. Operational Feasibility

The system is easy to use after integration. For API-based use, store owners must insert a lightweight JavaScript snippet into their checkout page. Once added, the system runs automatically without manual input, and admins can manage rules and logs through the dashboard.

3.1.2.3. Economic Feasibility

The project was built without any licensing or paid tools. Hosting and backend requirements are minimal, making it cost-effective.

In a feasibility study, three main aspects are considered: technical, operational, and economic feasibility. Among these, a Gantt chart is most closely related to technical and operational feasibility, as it helps in planning, scheduling, and monitoring project tasks. While it does not directly measure economic feasibility, it can indirectly support cost management by identifying potential delays or resource issues.

Gant chart:

The purpose of a Gantt chart is to help people see and understand the schedule of a project. It shows all the tasks that need to be done, when they start, and when they finish.

Table 1: Activity Table of FraudShield

Task	Duration	Start Date	End Date	Week Number																				
				W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22
Planning	2 weeks	Jan 29, 2025	Feb 11, 2025	✓	✓																			
Requirement	3 weeks	Feb 12, 2025	Mar 4, 2025			✓	✓	✓																
Design	3 weeks	Mar 5, 2025	Mar 25, 2025						✓	✓	✓													
Development	13 weeks	Mar 26, 2025	Jun 22, 2025									✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Testing	1 week	Jun 23, 2025	Jun 29, 2025																					✓
Documentation	22 weeks	Jan 29, 2025	Jun 29, 2025	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

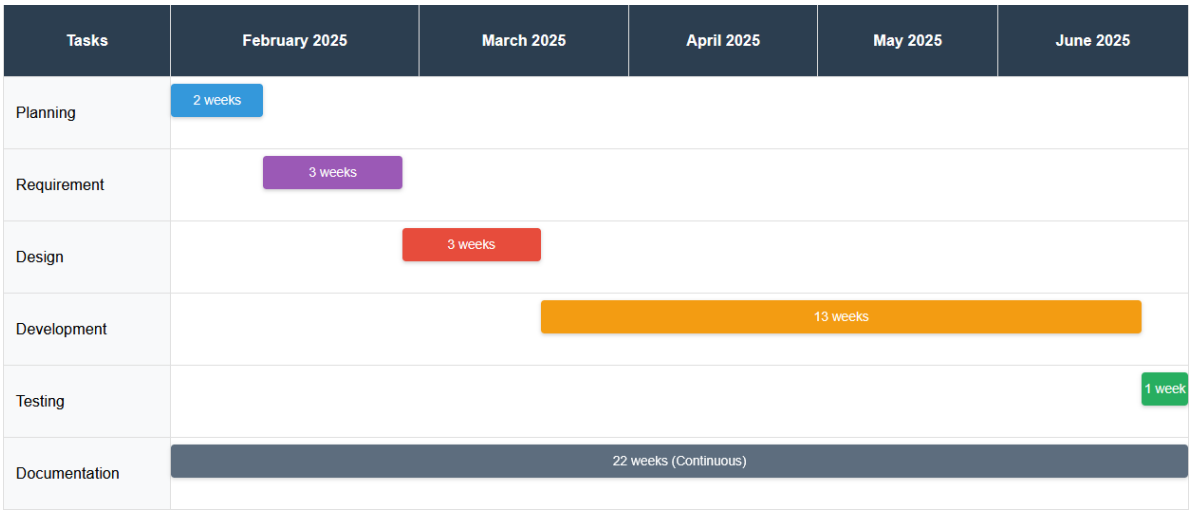


Figure 3: Gannt Chart of FraudShield

3.1.3. Object Modelling

Object modelling is used to represent the static structure of the system. It includes class diagrams that define the classes, their attributes, methods, and relationships. Alongside, object diagrams show actual instances of those classes with real data. This helps in understanding how different parts of the system are connected and interact at the data level.

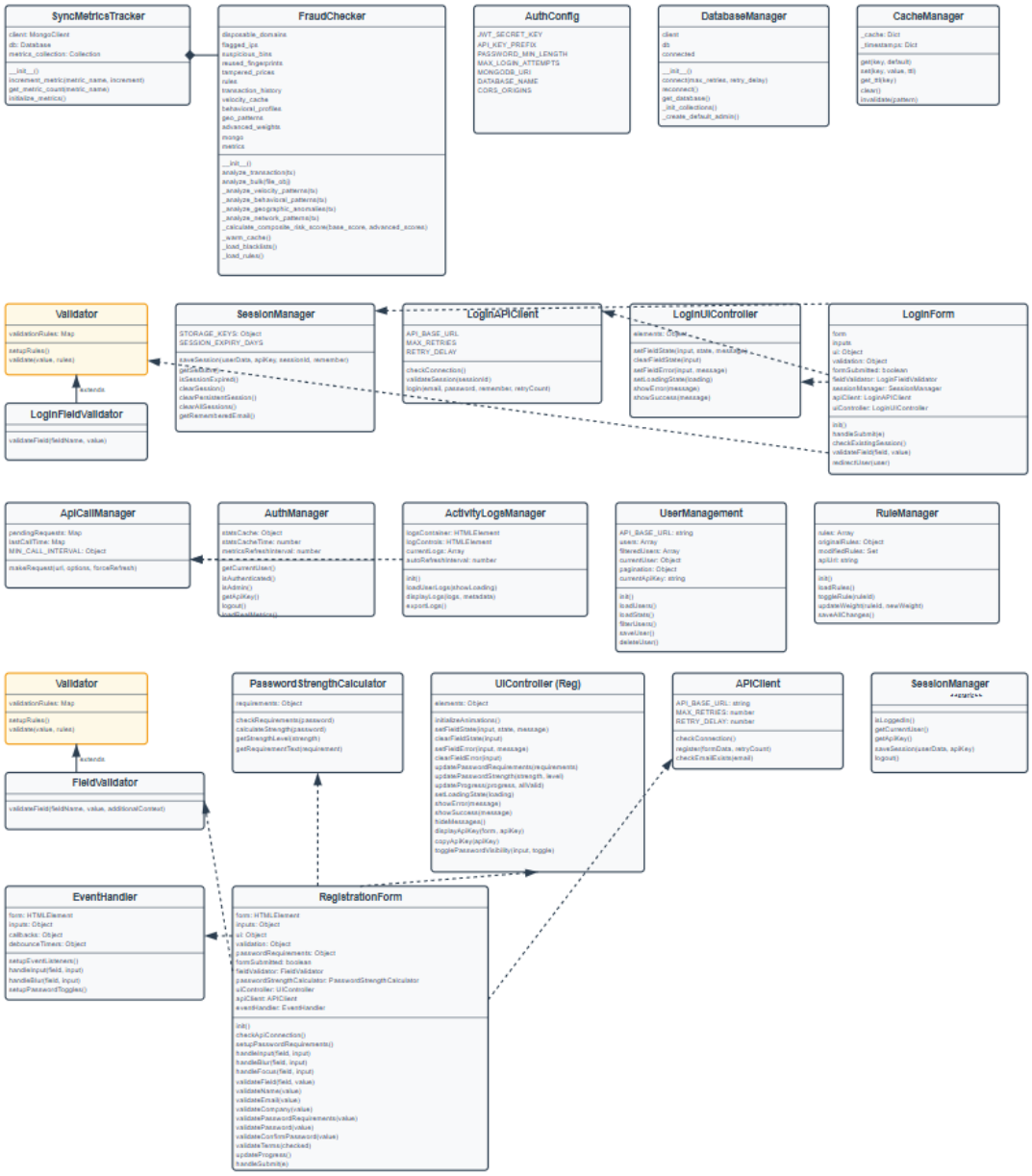


Figure 4: Class Diagram of FraudShield

3.1.4. Dynamic Modeling (State & Sequence diagram)

A state diagram shows how an object changes its state based on events. It helps to track object behavior from one state to another, like Login → Dashboard → Logout. This is useful to model lifecycle and control flow in the system.

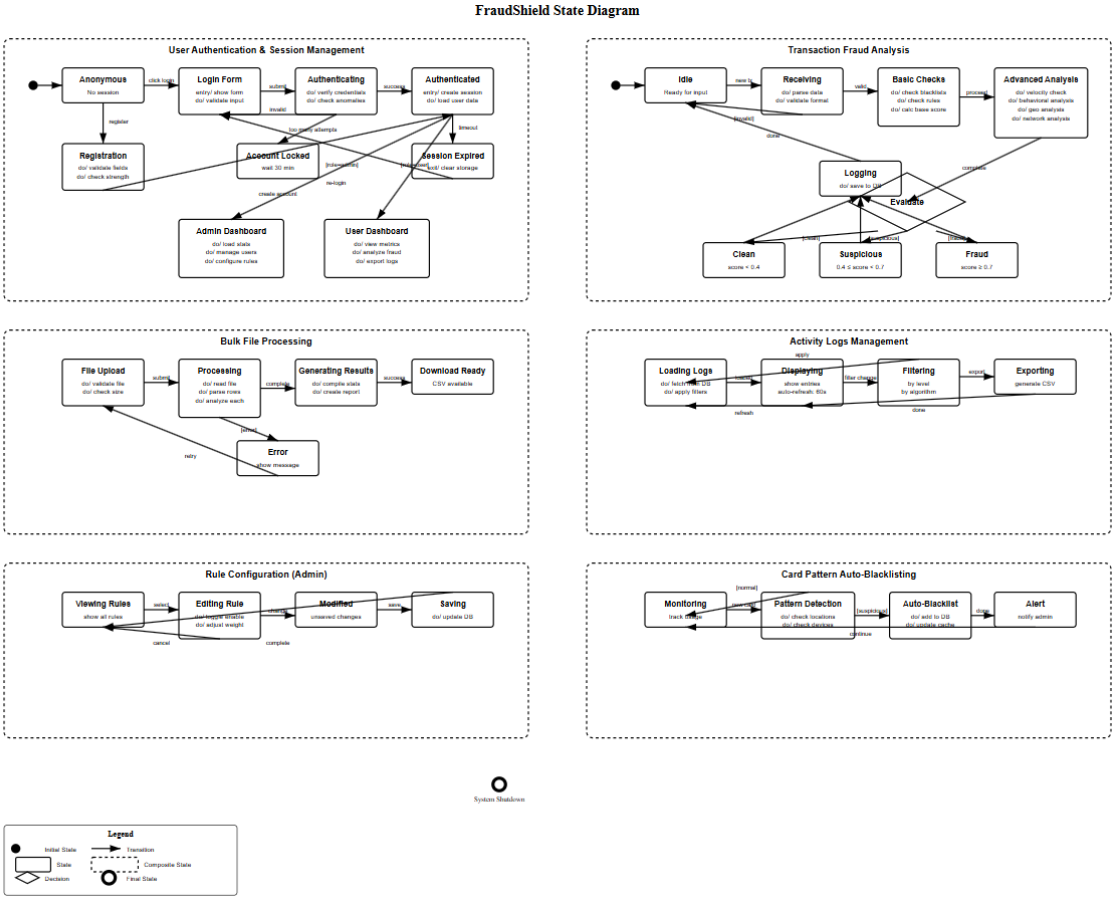


Figure 5: State Diagram of FraudShield

A sequence diagram shows how objects interact with each other in a specific order. It displays the flow of messages between objects over time. This helps to understand the step-by-step process of a use case.

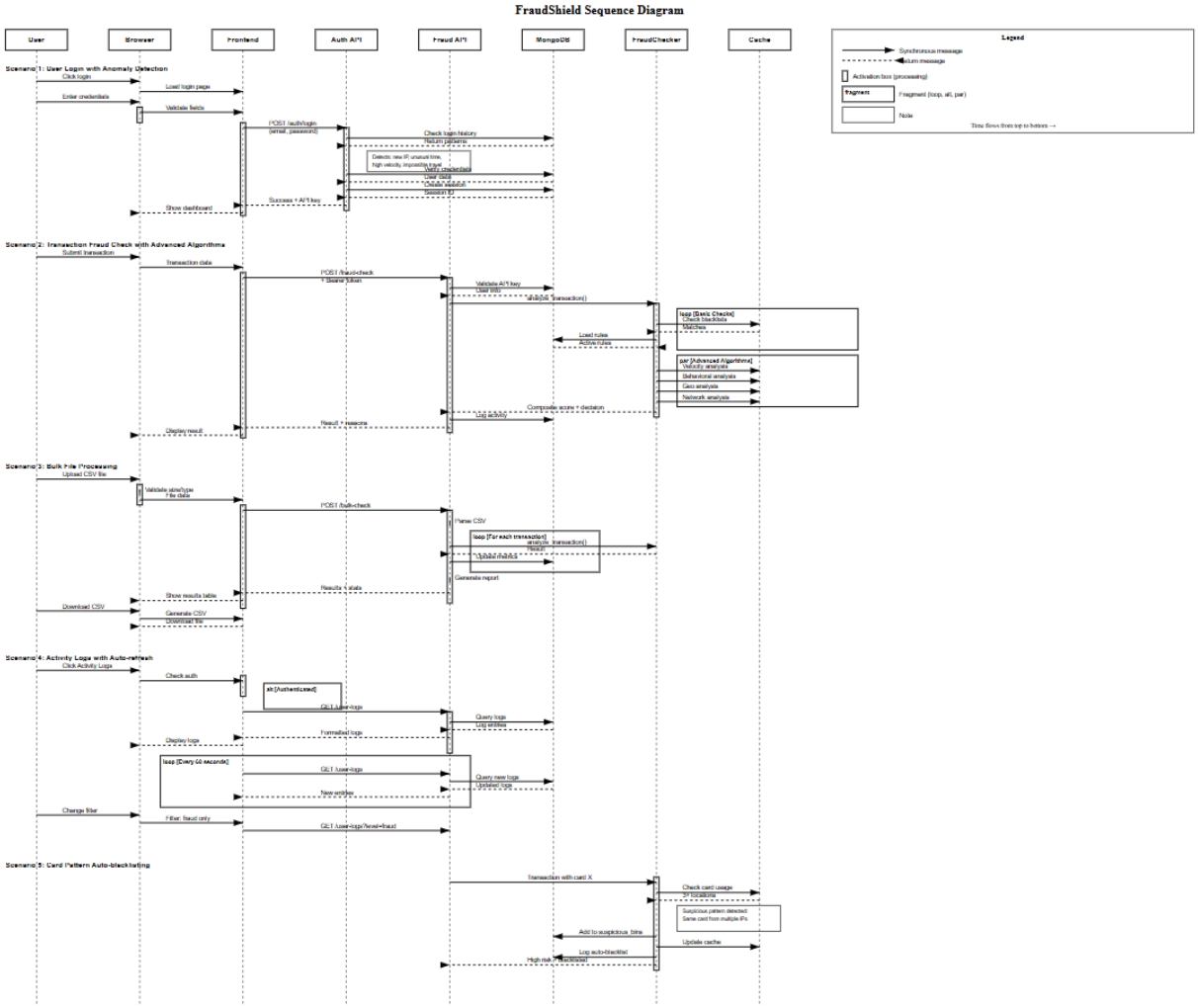


Figure 6: Sequence Diagram of FraudShield

3.1.5 Process modelling: Activity Diagram

An activity diagram shows the flow of actions or processes in the system. It's like a flowchart that represents different steps from start to end. This helps to understand how the system behaves during different operations.

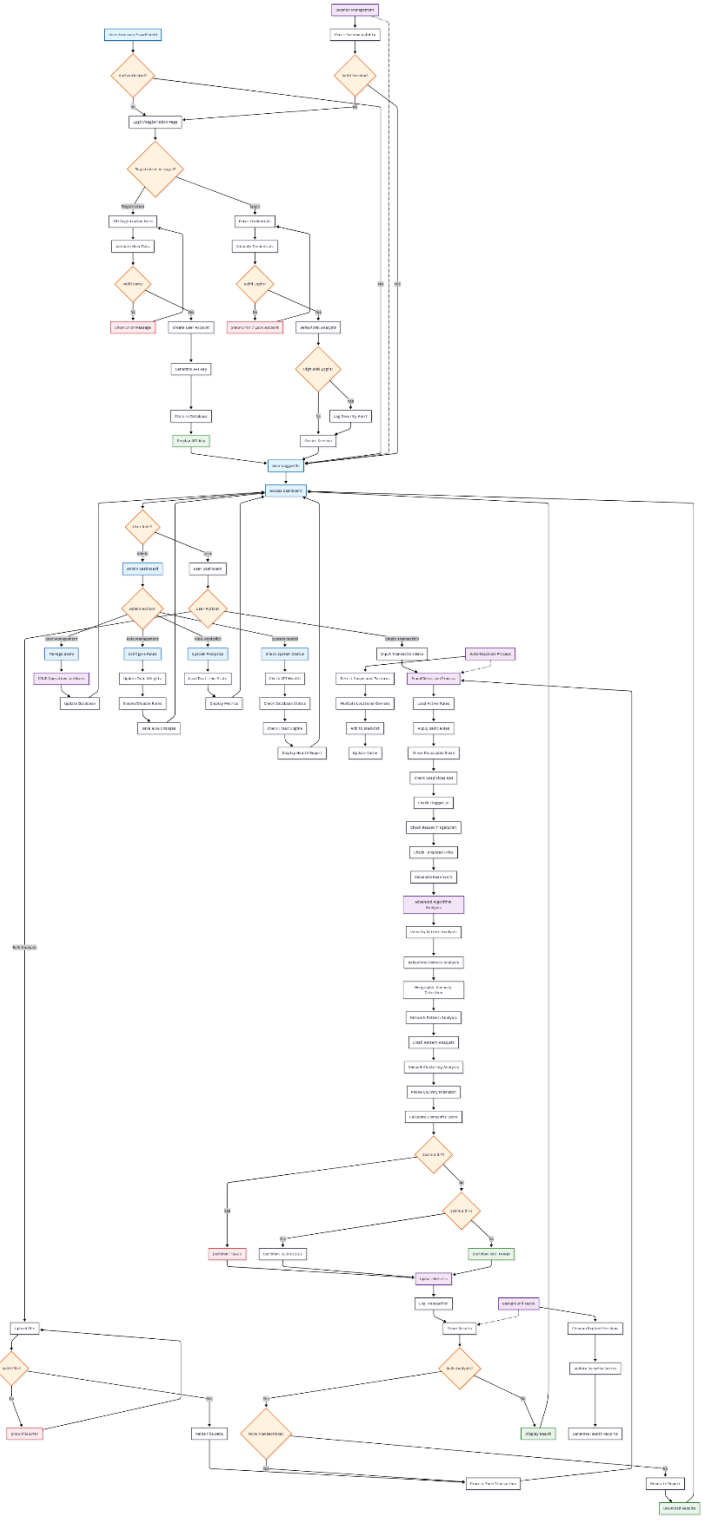


Figure 7: Activity Diagram of FraudShield

3.2. System Design

System design is the process of defining the architecture, components, interfaces, and data for a software system to meet specific requirements.

3.2.1. Refinement of Classes and Object

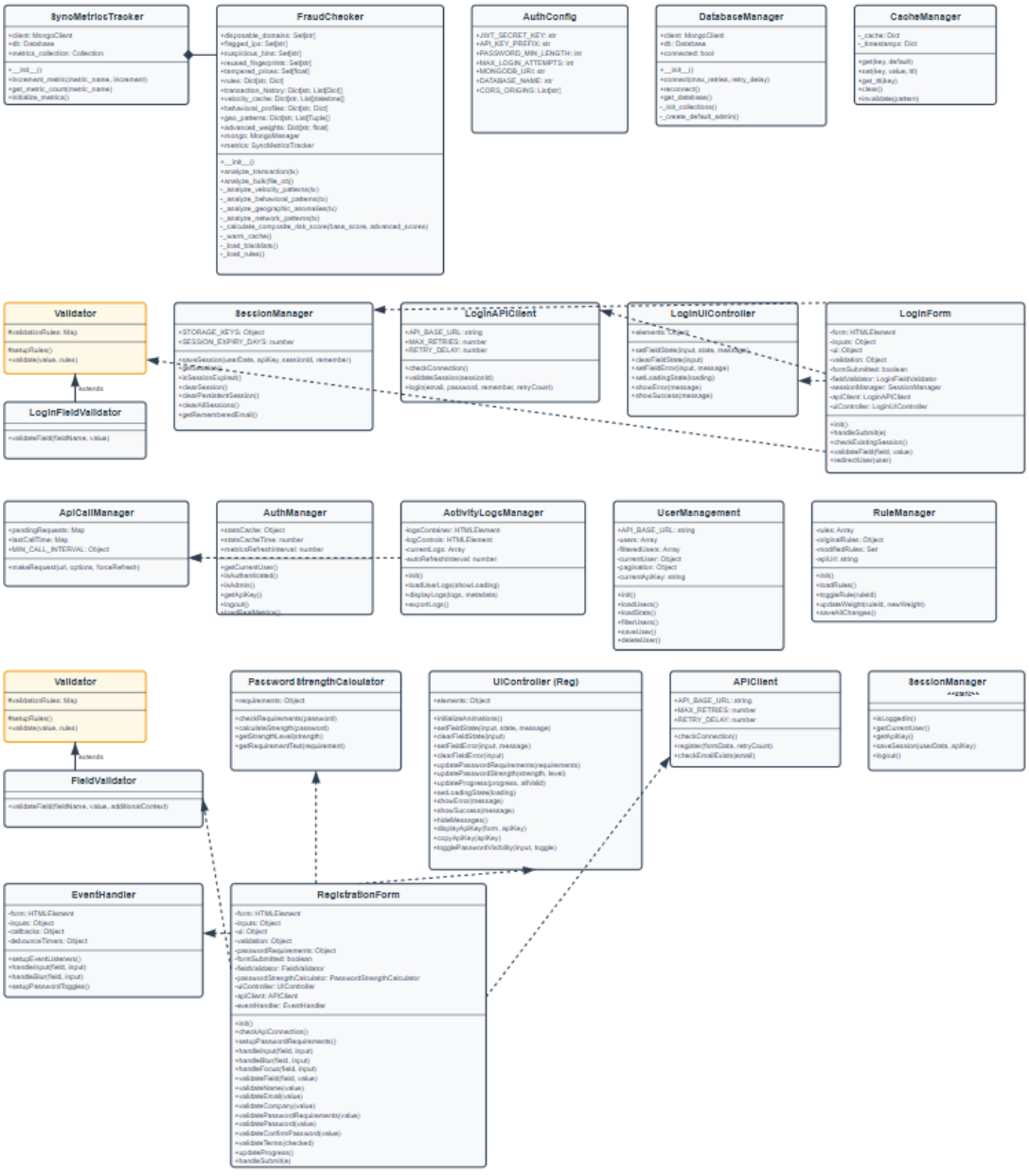


Figure 8: Refinement of Class Diagram of FraudShield

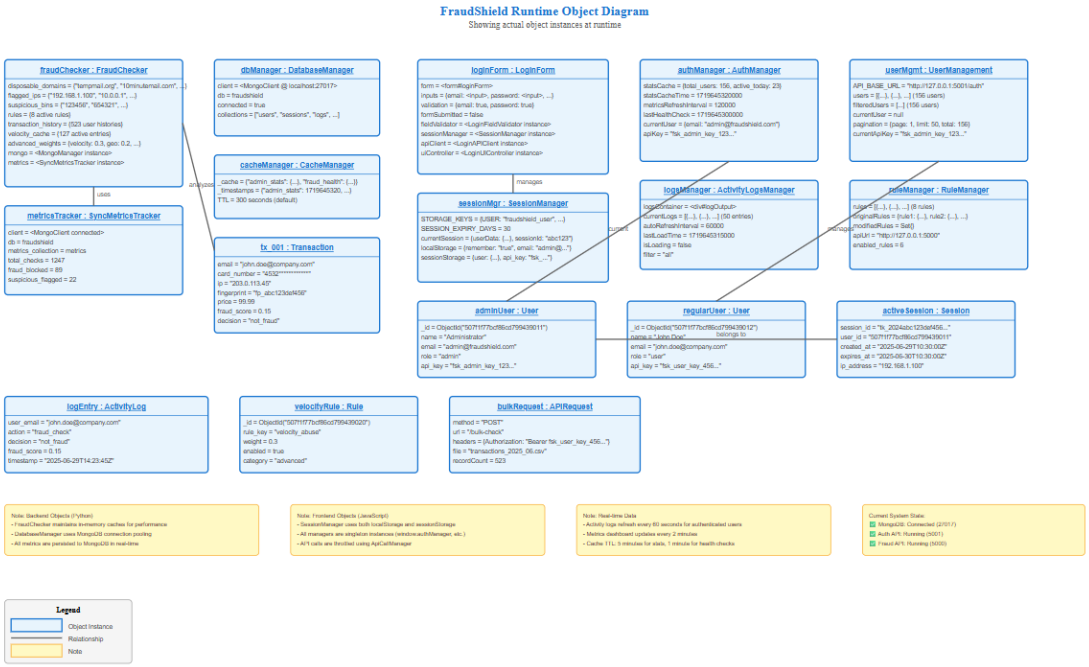


Figure 9: Refinement of Object Diagram of FraudShield

3.2.2. Component Diagram

A component diagram shows the main parts (components) of the system and how they interact. It represents modules like login, database, or fraud detection as separate blocks. This helps in visualizing the system's structure at a higher level.

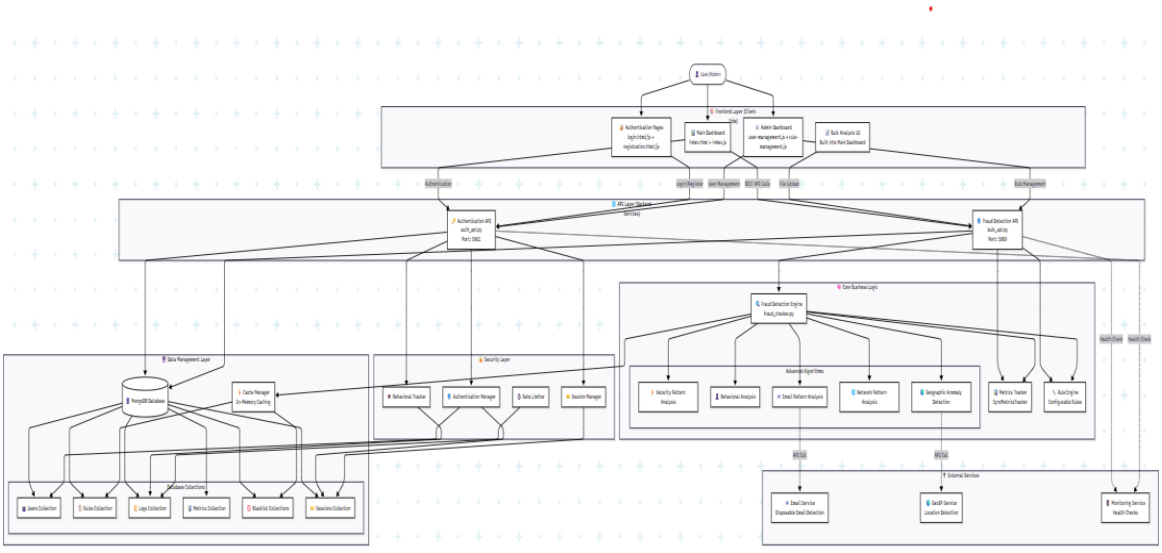


Figure 10: Component Diagram of FraudShield

3.2.3. Deployment Diagram

A deployment diagram shows how the system is physically deployed on hardware. It includes nodes like servers, databases, and client devices, and how they are connected. This helps to understand where and how each part of the system runs.

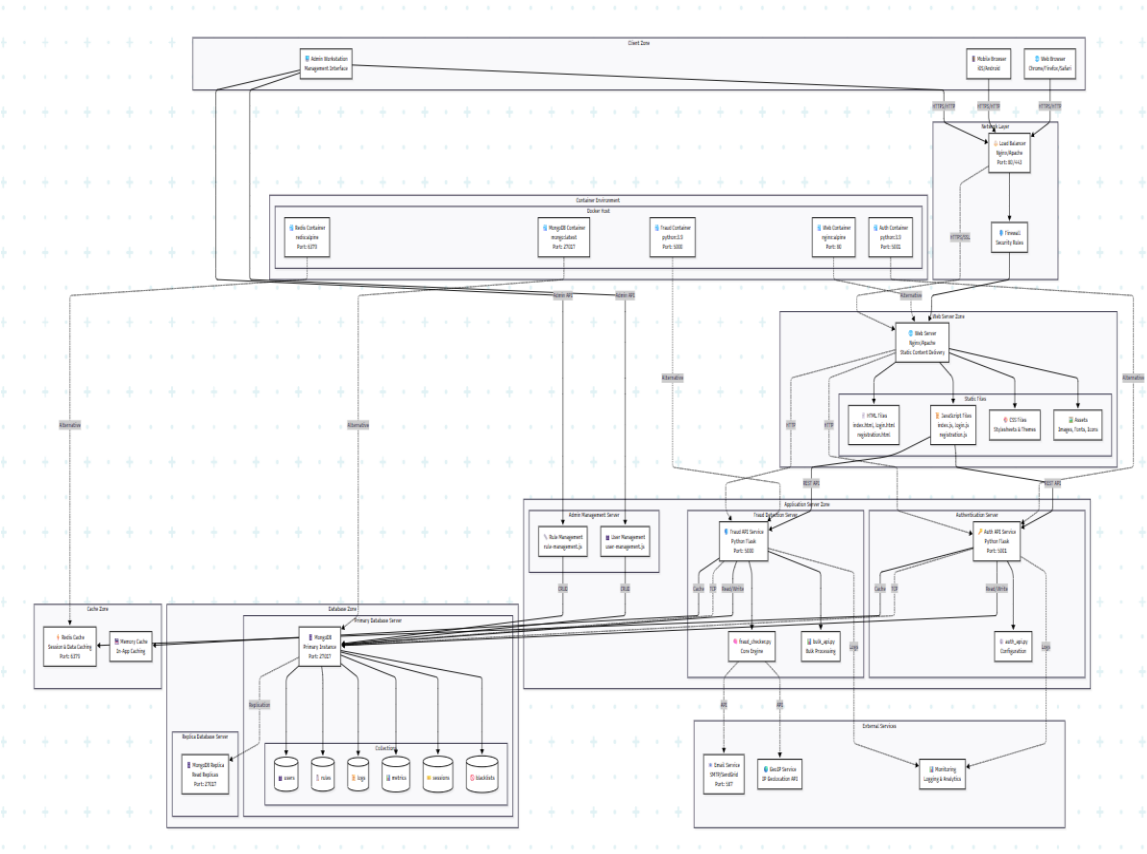


Figure 11: Deployment Diagram of FraudShield

3.3. Algorithm Details

3.3.1 3-Velocity Pattern Detection Algorithm

Purpose: This catches fraudsters who try many transactions quickly.

Algorithm Steps:

1. Store each transaction timestamp for user email
2. When new transaction comes, count how many in:
    - Last 1 minute (limit: 3)
    - Last 5 minutes (limit: 5)
    - Last 1 hour (limit: 10)
3. If over limit, add 0.3 to fraud score
4. Delete timestamps older than 24 hours

Code:

```
for window_name, window_delta in time_windows.items():
   cutoff = current_time - window_delta
   recent_txs = [t for t in self.velocity_cache[email] if t >= cutoff]
   threshold = thresholds[window_name]
   if len(recent_txs) > threshold:
      velocity_score = min(0.3, (len(recent_txs) - threshold) * 0.05)
      score += velocity_score
```

Location: _analyze_velocity_patterns() in fraud_checker.py

3.3.2 Behavioral Deviation Algorithm

Purpose: Checks if transaction amount is abnormal for this user.

Algorithm Steps:

1. Get user's transaction history (last 30 days)
2. Calculate average amount and standard deviation
3. If current amount is more than 3 standard deviations from average, flag it

4. Add 0.15 to fraud score if flagged

Formula: |current_amount - average| > 3 × standard_deviation

Code:

```
if std_amount > 0 and abs(current_amount - avg_amount) > 3 * std_amount:
    score += 0.15
if hour_counts[current_hour] == 0 and len(historical_hours) > 5:
    score += 0.1


if current_ip and current_ip not in historical_ips and len(historical_ips) < 3:
    score += 0.1
```

Location: _analyze_behavioral_patterns() in fraud_checker.py

3.3.3 Composite Score Calculation

Purpose: Combines all rule scores into final fraud score.

Algorithm Steps:

1. Add all rule weights (base score)
2. Add all algorithm scores (advanced score)
3. Final = (base × 0.7) + (advanced × 0.3)
4. If many rules triggered, multiply score by 1.1 to 1.3
5. Return final score (0.0 to 1.0)

Code:

```
total_advanced_score = sum(score * self.advanced_weights.get(algo, 0.1) for algo, score in advanced_scores.items())
if base_score >= 0.6:
    composite_score = base_score * 0.7 + total_advanced_score * 0.3
elif base_score >= 0.3:
    composite_score = base_score * 0.6 + total_advanced_score * 0.4
```

```
else:
    composite_score = base_score * 0.5 + total_advanced_score * 0.5
rules_triggered = len(advanced_scores)
if rules_triggered >= 10:
    composite_score *= 1.3
elif rules_triggered >= 7:
    composite_score *= 1.2
elif rules_triggered >= 5:
    composite_score *= 1.15
elif rules_triggered >= 3:
    composite_score *= 1.1
else:
    composite_score *= 1.05
if base_score >= 0.8:
    composite_score = max(composite_score, 0.7)
elif base_score >= 0.6:
    composite_score = max(composite_score, 0.5)
elif base_score >= 0.4:
    composite_score = max(composite_score, 0.35)
final_score = min(composite_score, 0.99)
```

Location: _calculate_composite_risk_score() in fraud_checker.py

CHAPTER 4:

IMPLEMENTATION AND TESTING

4.1. Implementation

This phase includes writing the code for the system, creating the user interface, and setting up the database. Various programming languages and tools are used to build each part of the system.

4.1.1. Tools Used

- Programming Languages: HTML, CSS, JavaScript (for frontend), Python Flask (for backend logic), and MongoDB (for database) for system's development.
- Development Environment: Tools such as VS Code for coding, draw.io for diagrams, git for version control, and Firefox as browser.

4.1.2. Implementation Details of Modules

fraud_checker.py

SyncMetricsTracker

Code:

```
result = self.metrics_collection.update_one(
    {"_id": metric_name},
    {
        "$inc": {"count": increment},
        "$set": {"last_updated": datetime.now()}
    },
    upsert=True
)
```

- Tracks fraud detection metrics in MongoDB synchronously
- Key methods: increment_metric(), get_metric_count()

FraudChecker

Code:

```
total_rules = len(all_reasons)
if total_rules >= 5:
    # Many rules triggered - boost the score significantly
    rule_penalty = min(0.05 * total_rules, 0.5)
    composite_score = min(composite_score + rule_penalty, 0.99)
    # Ensure minimum scores for many violations
    if total_rules >= 12:
        composite_score = max(composite_score, 0.95)
    elif total_rules >= 10:
        composite_score = max(composite_score, 0.9)
    elif total_rules >= 8:
        composite_score = max(composite_score, 0.85)
    elif total_rules >= 6:
        composite_score = max(composite_score, 0.75)
```

- Core fraud detection engine with multiple algorithms
- Key methods: analyze_transaction(), analyze_bulk()
- Maintains blacklists and implements velocity, behavioral, and geographic analysis

bulk_api.py

Config

- API configuration (file size limits, allowed extensions)

DatabaseManager

Code:

```
mongo_client = pymongo.MongoClient("mongodb://localhost:27017")
auth_db = mongo_client.fraudshield
users_collection = auth_db.users
```

audit_logs_collection = auth_db.audit_logs

transactions_collection = auth_db.transactions

app.logger.info(" Authentication database connected")

- MongoDB connection with retry logic
- Key methods: validate_apikey(), get_database()

auth_api.py

AuthConfig

- Authentication settings

DatabaseManager

Code:

self.client = pymongo.MongoClient(

AuthConfig.MONGODB_URI,

serverSelectionTimeoutMS=5000,

connectTimeoutMS=5000,

socketTimeoutMS=5000

)

Test connection and db access

self.client.server_info()

self.db = self.client[AuthConfig.DATABASE_NAME]

self.db.users.count_documents({}, limit=1)

self.connected = True

logger.info("MongoDB connection established successfully")

Initialize collections if needed

self._init_collections()

return True

- Auth database connection and initialization
- Creates indexes and default admin user

CacheManager

```
def get_ttl(self, key: str) -> int:
    """Get TTL for specific cache keys"""
    if 'admin_stats' in key:
        return 300  # 5 minutes for admin stats
    elif 'fraud_health' in key:
        return 60   # 1 minute for health checks
    elif 'user_stats' in key:
        return 180  # 3 minutes for user stats
    elif 'fraud_detection_stats' in key:
        return 120  # 2 minutes for fraud stats
    return 300  # Default 5 minutes
```

- In-memory cache with TTL support
- Caches stats and health checks

index.js

ApiCallManager

Code:

```
// Check if we're calling too frequently
if (!forceRefresh) {
    const lastCall = this.lastCallTime.get(fullUrl);
    const minInterval = this.MIN_CALL_INTERVAL[fullUrl] || 10000;
    if (lastCall && (Date.now() - lastCall) < minInterval) {
```

```
console.log(`⏳ Skipping ${fullUrl} - called too recently (${Math.round((Date.now() - lastCall) / 1000)}s ago)`);
return null;
    }
}
```

- Prevents API spam with request deduplication
- Enforces minimum call intervals

AuthManager

Code:

```
    static isAuthenticated() {
        // Check both sessionStorage and localStorage
        const sessionUser = sessionStorage.getItem('fraudshield_user');
        const sessionApiKey = sessionStorage.getItem('fraudshield_api_key');
        const persistentUser = localStorage.getItem('fraudshield_persistent_user');
        const persistentApiKey = localStorage.getItem('fraudshield_persistent_api_key');
        return !!(
            (sessionUser && sessionApiKey) ||
            (persistentUser && persistentApiKey)
        );
    }
```

- Dashboard authentication and role management
- Handles metrics loading and user interface

ActivityLogsManager

Code:

```
async loadUserLogs(showLoading = true) {
    // Check if we're loading too frequently
    const timeSinceLastLoad = Date.now() - this.lastLoadTime;
    if (!showLoading && timeSinceLastLoad < this.minLoadInterval) {
        console.log(`📋 Logs loaded ${Math.round(timeSinceLastLoad / 1000)}s ago, skipping auto-refresh`);
        return;
    }
```

- Displays and filters user activity logs
- Auto-refresh and export functionality

login.js

LoginForm

```
const response = await fetch(`${this.API_BASE_URL}/login`, {
    method: 'POST',
    headers: {
        'Content-Type': 'application/json'
    },
    body: JSON.stringify({
        email: email,
        password: password,
        remember: remember
    })
```

- Main login orchestrator
- Handles validation, API calls, redirects

user-management.js

UserManagement

Code:

```
const searchTerm = document.getElementById('searchInput').value.trim();

const roleFilter = document.getElementById('roleFilter').value;

if (searchTerm) params.search = searchTerm;

if (roleFilter) params.role = roleFilter;

const result = await this.api.get('/users', params);

if (result.success) {

   this.users = result.data.users || [];

   this.pagination = result.data.pagination || this.pagination;

   this.filteredUsers = [...this.users];

   this.renderUsers();

} else {

   throw new Error(result.error || 'Failed to load users');

}
```

- Admin CRUD operations for users
- Search, filter, pagination features

rule-management.js

RuleManager

Code:

```
   rulesToRender.forEach(rule => {

      const category = rule.category || 'uncategorized';

      if (!filteredCategories[category]) {

         filteredCategories[category] = [];
```

```
        }
        filteredCategories[category].push(rule);
    });
    Object.entries(filteredCategories).forEach(([category, rules]) => {
        const section = this.createCategorySection(category, rules);
        container.appendChild(section);
    });
    }
}
```

- Configure fraud detection rules and weights
- Batch updates with change tracking

4.2. Testing

Testing is the crucial process of evaluating and verifying that a software to ensures that the application functions correctly and meets user expectations.

4.2.1. Test Cases for Unit Testing

Table 2: Unit Testing

S.N	Description	Input	Expected Outcome	Actual Outcome	Result
1	Temporary email detection	Email: something@tempmail.com	Fraud score with reason.	Fraud score with reason.	Pass
2	Country code mismatch detection	Country code: +91 Billing Country: US	Flagged as "phone_country_mismatch", score ≥ 0.15	No flag raised, score: 0.0	Fail
3	Negative price validation	Price: -99.99	Error: "Invalid price value".	Transaction proceeds	Fail

4	Normal Email	Email: bijay@gmail.com	Success	Success	Pass
5	Country Code mismatch with billing	Country code : +91 Billing Country: US	Flagged as number mismatch.	Flagged as number mismatch.	Pass

4.2.2. Test Cases for System Testing

Table 3: System Testing

Test id	Description	Input	Expected Outcome	Actual Outcome	Result
1	Public bulk check with oversized file	Upload 20MB CSV file (limit is 16MB)	Error: "File too large. Maximum size: 16MB"	Server timeout after 30 seconds No error message	Fail
2	Fraud check via API	Valid Transaction JSON from integrated website	Fraud score with reason returned	Fraud score with reason returned	Pass
3	Database connection failure	Disconnect database during transaction processing	Graceful error: "Service temporarily unavailable"	Application crash with stack trace exposed	Fail
4	Public bulk check	Uploaded CVS with 10 email+IP entries	Results returned with fraud flags per entry	Results returned with flags per entry	Pass
5	Response Time check	Given 40 data in .json for bulk check	Less than a second	Processing time: 0.56s	Pass
6	Same data test	Same json given from 5 number	Must be same result overall in	Same analysis result (in numbers)	Pass

CHAPTER 5: CONCLUSION AND FUTURE RECOMMENDATIONS

5.1. Conclusion

FraudShield successfully fulfills its objective of detecting potentially fraudulent transactions through both manual input and API integration. The system supports secure registration, real-time fraud scoring, rule-based evaluation, and administrative control. Unit and system testing confirmed that the platform behaves as expected in various scenarios. Overall, FraudShield is a reliable and effective solution for enhancing transaction security.

5.2 Lesson Learnt / Outcome

Through the development of FraudShield, we gained hands-on experience in designing secure, scalable fraud detection systems. We learned how to integrate rule-based logic, manage user roles, and build an API-driven architecture. Testing highlighted the importance of edge case handling and real-time response. Overall, the project strengthened our skills in system design, backend logic, and application security.

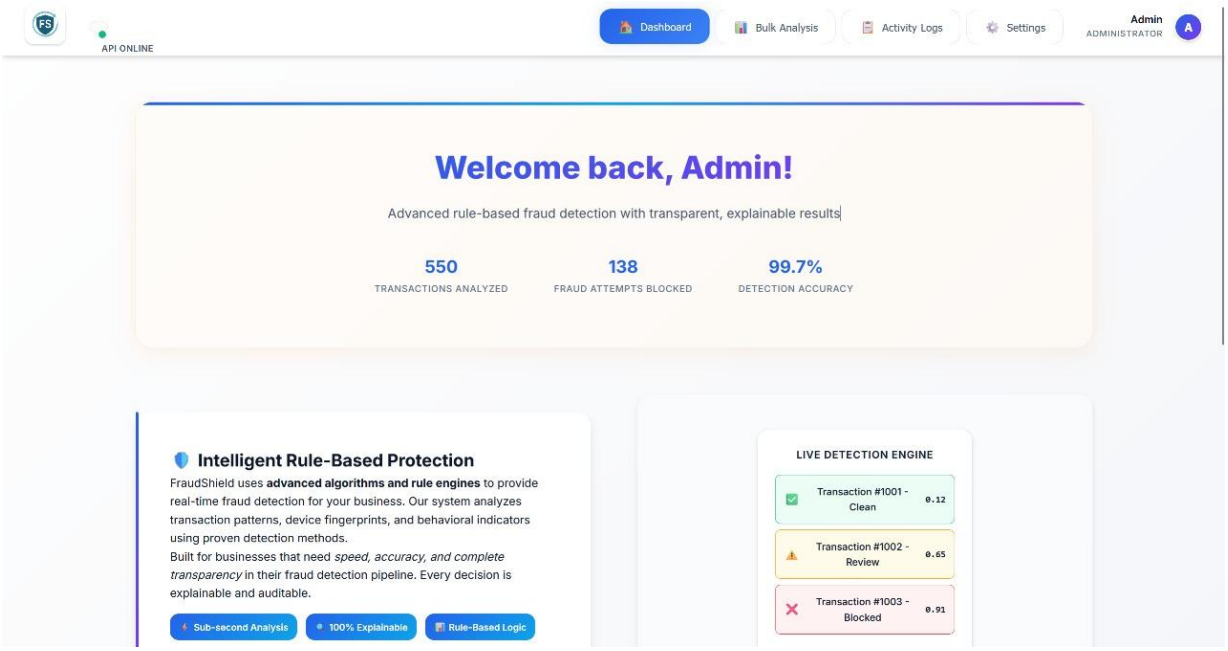
5.3. Future Recommendation

Down the line there are various functionalities that can be integrated into the system such as:

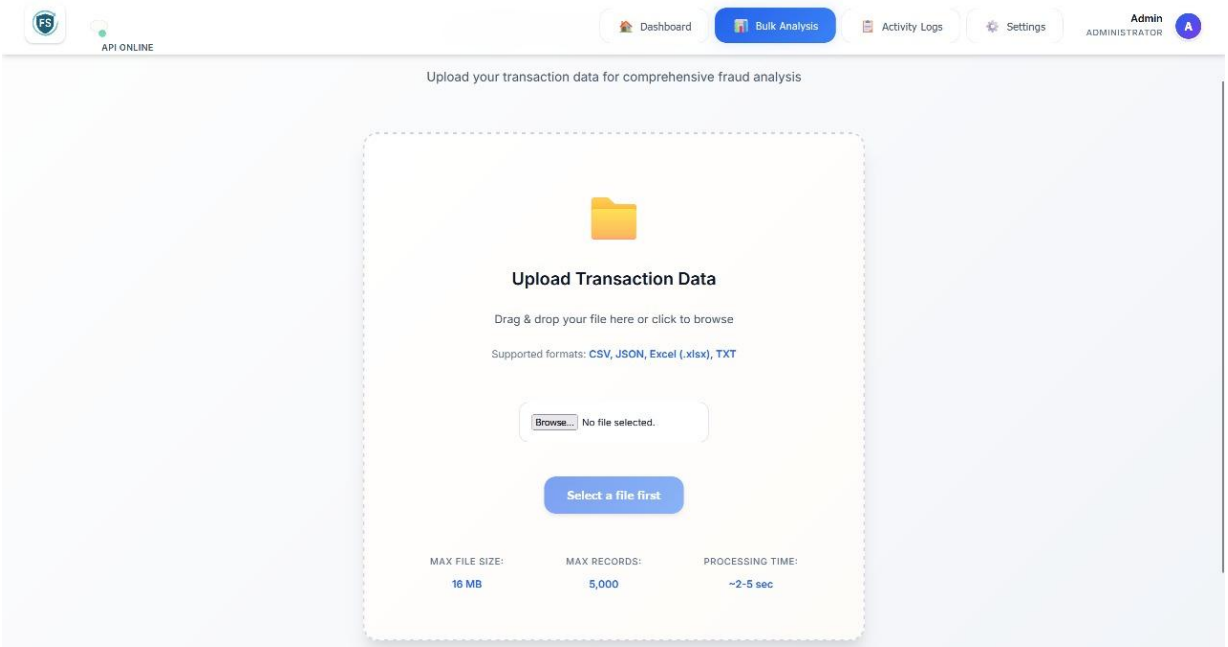
- Integrate machine learning to enhance fraud detection accuracy and adapt to evolving patterns.
- Optimize the existing codebase to improve system performance and reduce response time.
- Allow site owners to set custom fraud score thresholds based on their business needs.
- Provide site owners the ability to manually blacklist specific emails, devices, or IPs from their dashboard.

APPENDICES

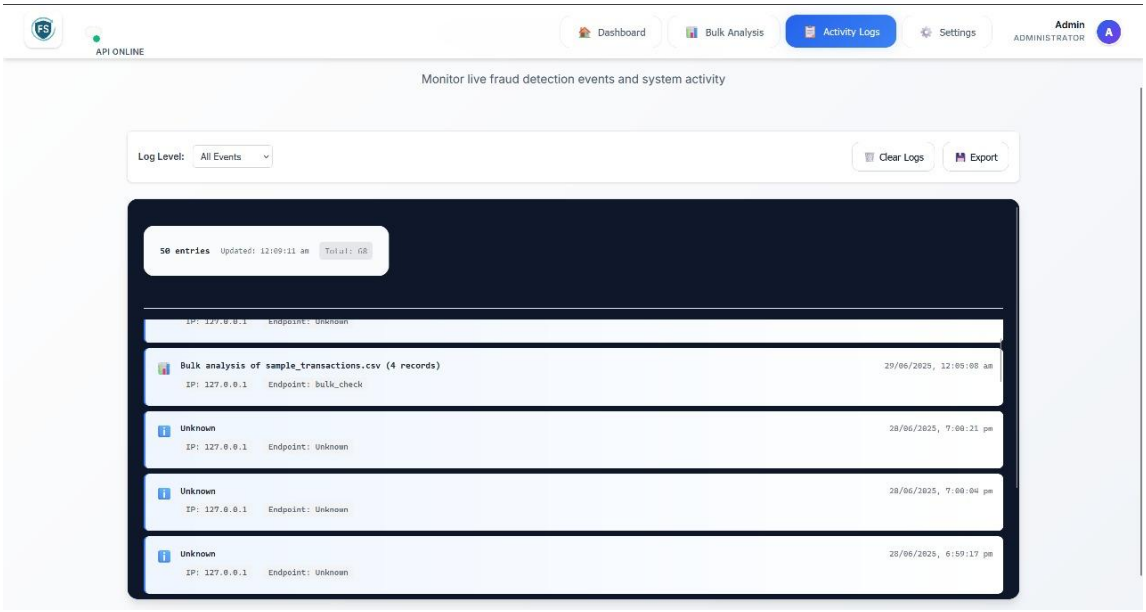
Homepage



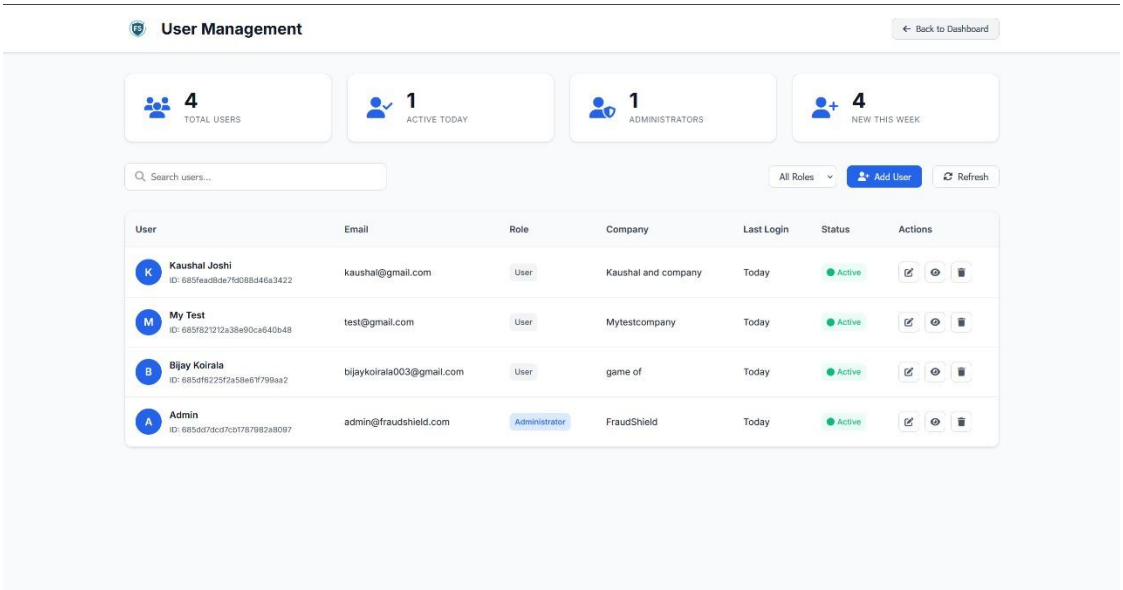
Bulk analysis page



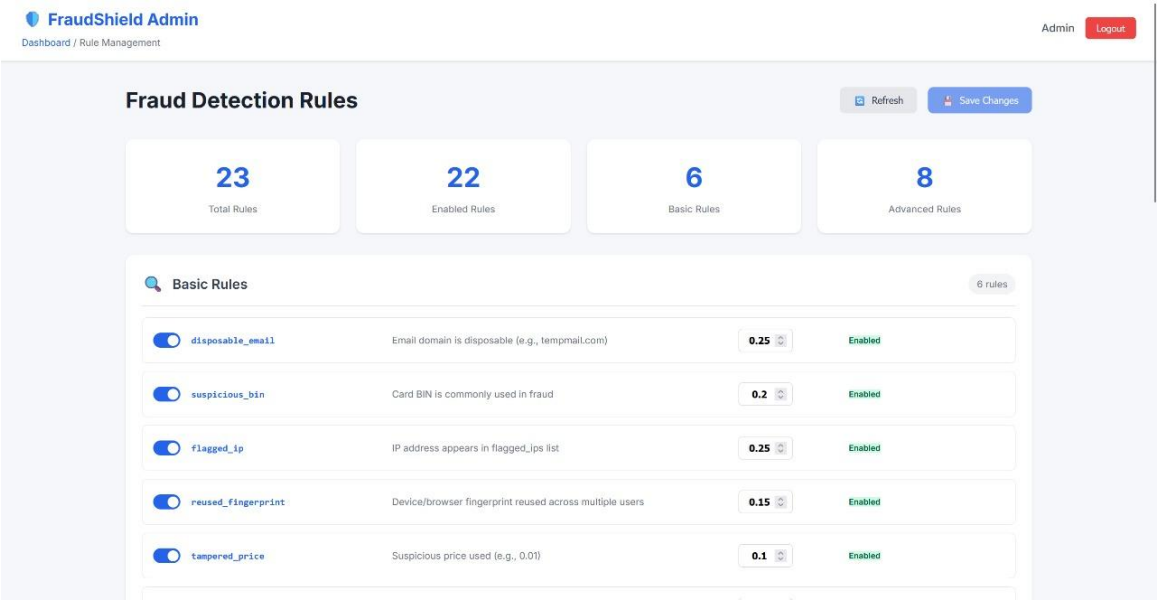
Log Page



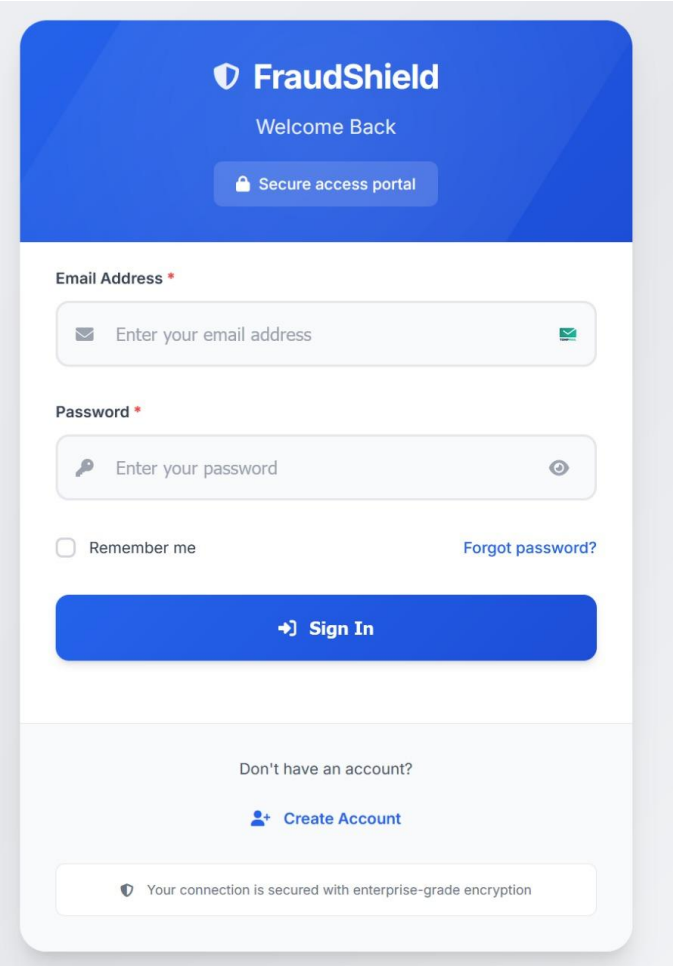
User management (admin page)



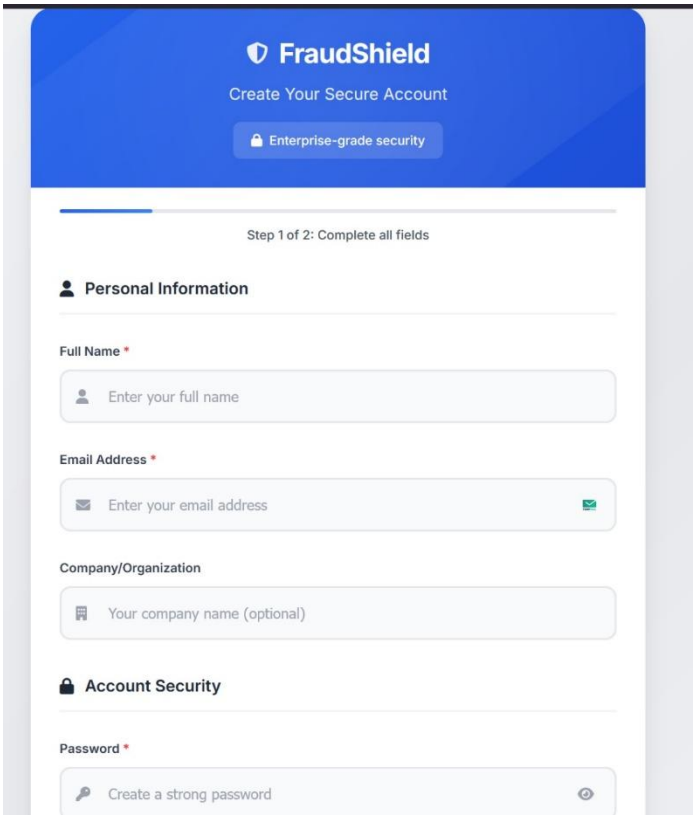
Rules management (admin page)



Login page



Registration page



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