

# DriveGuard AI - Video Analysis System

## Non-Functional Requirements (NFR)

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## 1. Performance Requirements

### 1.1 Video Processing Performance

- Hardware Configuration:
  - Processor: Apple Silicon (ARM64)
  - GPU: Metal Performance Shaders (MPS)
  - Operating System: macOS 15.6.1

Metric	Specification	Measured Performance
Processing Ratio		
1-minute video	~2 minutes	<input type="checkbox"/> Verified
2-minute video	~4-5 minutes	<input type="checkbox"/> 5:14 actual
5-minute video	~10-11 minutes	Estimated
GPU Acceleration	Apple Silicon MPS	<input type="checkbox"/> Active
Concurrent Processing	Sequential (1 video at a time)	Current limitation

### 1.2 System Response Times

Operation	Target Response Time	Status
User Login	< 500ms	<input type="checkbox"/> Met
Dashboard Load	< 1 second	<input type="checkbox"/> Met
API Endpoints (non-analysis)	< 100ms	<input type="checkbox"/> Met
Video Upload	Dependent on file size	Network-bound
Analysis Status Check	< 50ms	<input type="checkbox"/> Met

## 2. Scalability Requirements

### 2.1 User Capacity

- **Current Capacity:**

Metric	Current Capacity	Notes
Registered Users	Unlimited (file-based)	Database migration recommended
Concurrent Sessions	Up to 10 users	Limited by server resources
Analyses per User	Unlimited	Storage-dependent
Video Storage	Local file system	~50GB available

## 2.2 System Throughput

- **Future Scalability:**

Metric	Specification
Videos per Hour	~12-15 videos (2-3 min avg)
Daily Processing Capacity	~150-200 videos
Peak Load Handling	Single sequential processing queue

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# 3. Reliability & Availability

## 3.1 System Uptime

Requirement	Specification
Target Uptime	99% during development
Maximum Downtime	Planned maintenance windows
Recovery Time Objective (RTO)	< 5 minutes
Recovery Point Objective (RPO)	Last successful analysis

## 3.2 Data Integrity

- **Analysis Results:** Stored in JSON format with validation.
  - **Video Files:** Original files are preserved post-analysis.
  - **User Data:** File-based storage with backup capability.
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# 4. Security Requirements

## 4.1 Authentication & Authorization

Feature	Implementation	Status
User Authentication	Password-based login	<input type="checkbox"/> Implemented
Password Encryption	Plaintext (requires enhancement)	<input type="checkbox"/> Implemented
Session Management	Cookie/JWT-based	Implemented
Role-Based Access	Individual/Enterprise accounts	<input type="checkbox"/> Implemented

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# 5. Usability Requirements

## 5.1 User Interface

Requirement	Specification
Framework	React 18+ TypeScript
Responsive Design	Desktop and tablet optimized
Dark/Light Mode	Toggle available

## 5.2 User Experience

Feature	Target	Status
Video Upload Flow	< 3 clicks	<input type="checkbox"/> Met
Analysis Results Display	< 2 seconds load	<input type="checkbox"/> Met
Dashboard Navigation	Intuitive layout	<input type="checkbox"/> Met
Error Messages	Clear, actionable feedback	<input type="checkbox"/> Met
Progress Indicators	Real-time processing status	<input type="checkbox"/> Met

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# 6. Portability & Compatibility

## 6.1 Platform Requirements

Component	Requirement
Operating System	macOS 12+ (Apple Silicon optimized)
Python Version	3.10 or higher
Node.js Version	18.x or higher
GPU Support	Apple Silicon MPS (or CUDA for NVIDIA)

## 6.2 Dependencies

- Python Dependencies:
    - OpenCV (cv2) - Video processing
    - PyTorch - Deep learning framework
    - YOLOv8 - Object detection
    - NumPy - Numerical computations
    - Ultralytics - YOLO implementation
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# 7. AI Model Performance

## 7.1 Detection Accuracy

Model	Task	Accuracy
YOLOv8n	Vehicle detection	~90%
Speed Detection	Speed estimation	$\pm 5$ (km/h) accuracy
Signal Detection	Traffic light violations	Rule-based validation

## 7.2 Scoring Algorithm

- Score Weights:

Score Component	Weight	Penalty Formula
Safety Score	50%	$(100 - (\text{close\_encounters} \times 8))$
Compliance Score	30%	$(100 - (\text{traffic\_violations} \times 40 + \text{bus\_lane} \times 30))$
Efficiency Score	20%	$(100 - (\text{lane\_changes} \times 0.5))$

- Score Categories:

- 90-100: Excellent - Outstanding performance
- 75-89: Good - Minor improvements needed
- 0-74: Needs Improvement - Safety concerns

# 8. Known Limitations & Future Enhancements

## 8.1 Current Limitations

- Sequential Processing:** Only one video can be analyzed at a time.
- Password Security:** Passwords are currently stored in plaintext.
- File-Based Database:** Not suitable for large-scale deployment.
- No Real-Time Processing:** Videos must be uploaded and queued for analysis.
- GPU Dependency:** Optimal performance requires Apple Silicon MPS.

## 8.2 Recommended Enhancements

- Priority 1 (Critical):**
  - Implement password hashing (e.g., bcrypt/argon2).
  - Add HTTPS/TLS support.
  - Migrate to a dedicated database (e.g., PostgreSQL/MongoDB).
- Priority 2 (High):**
  - Enable parallel video processing using a multi-threading or queue system.
  - Introduce real-time video stream analysis.
  - Develop an advanced analytics dashboard.

- Implement API rate limiting and throttling.

- **Priority 3 (Medium):**

- Mobile app development.
- Add support for cloud deployment.
- Create an automated backup system.
- Implement advanced reporting features.