

**GalaxyALPR**

Automatic License Plate Recognition

# REST API Documentation



GALAXY

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# Galaxy ALPR REST API

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A robust REST API service for the Galaxy Automatic License Plate Recognition (ALPR) system. This backend powers real-time vehicle and license plate detection, integrates with AI/ML models for image analysis, manages detection data in a database, and serves results to a modern frontend dashboard.



## Features

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- **Image Upload & Detection**

- Upload vehicle/plate images for AI-powered detection
- Returns annotated images, detection metadata, and confidence scores

- **Detection Results & History**

- Fetch latest detection results
- Paginated history of all detection events
- Detailed record retrieval by vehicle or plate ID

- **Plate & Vehicle Management**

- CRUD operations for vehicle and plate records
- Region and type classification for plates
- Blacklist/whitelist management for access control

- **Statistics & Analytics**

- Real-time statistics for dashboard KPIs
- Vehicle/plate distribution, detection trends, and region analytics

- **Location & Session Management**

- Manage entry/exit locations
- Update and retrieve detection sessions

- **Static & Output File Serving**

- Download annotated images and detection artifacts

- **Health & Status Endpoints**
    - API and database health checks
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## Tech Stack

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- **API Framework:** Python 3.10+, FastAPI, Uvicorn
  - **Database:** SQLite, SQLAlchemy ORM
  - **AI/ML Integration:** YOLOv8/YOLOv11 (PyTorch), OCR (Gemini)
  - **HTTP Client:** httpx (for internal API calls)
  - **Logging:** Python logging module
  - **CORS:** FastAPI Middleware
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## Setup Guide

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### 1. Clone the Repository

```
git clone https://github.com/your-org/galaxy-alpr-backend.git
cd galaxy-alpr-backend/backend-api-endpoint
```

### 2. Create and Activate a Virtual Environment

```
python -m venv venv
source venv/bin/activate # On Windows: venv\Scripts\activate
```

### 3. Install Dependencies

```
pip install -r requirements.txt
```

### 4. Configure Environment Variables

- Copy `.env.example` to `.env` and update values as needed.

### 5. Run the Development Server

```
uvicorn app:app --reload
```

The API will be available at <http://localhost:8000>.

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## Environment Variables

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Create a `.env` file in the project root with the following variables:

```
GEMINI_API_KEY=your-gemini-api-key
```

- `GEMINI_API_KEY` : API key for Gemini OCR
- 

## API Documentation

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Interactive Swagger UI is available at:

<http://localhost:8000/docs>

## Example Endpoints

- **POST** `/detect_image`  
Upload an image for detection.  
**Input:** multipart/form-data ( `file` )  
**Output:** JSON with detection results, image URLs
- **GET** `/latest_detection`  
Fetch the most recent detection result.
- **GET** `/detections?limit=10&offset=0`  
Paginated list of detection events.
- **GET** `/api/vehicles/{vehicle_id}`  
Get detailed info for a specific vehicle.
- **GET** `/api/plates/{plate_id}`  
Get detailed info for a specific plate.
- **POST** `/api/plate-status`  
Add a plate to whitelist/blacklist.

- **GET** `/api/statistics/dashboard`  
Get dashboard statistics for frontend.

See `/docs` or `/redoc` for the full OpenAPI schema.



## API Documentation Preview

Below is a screenshot of the interactive Swagger UI, which provides a convenient way to explore and test all available API endpoints:

**YOLO License Plate Detection API** 1.0.0 GET POST

**default**

- POST** `/detect/image` Detect Image
- GET** `/api/detect/location` Get Detect Location
- GET** `/api/detect/location` Get Detect Location
- GET** `/api/detect/location` Get Detect Location
- GET** `/api/plates/regions` Get Plate Regions
- GET** `/api/plates/regions/{code}` Get Plate Region by Code
- GET** `/api/plates/regions/summary` Get Plate Regions Summary
- GET** `/api/plates/{plate_id}` Get Plate Details
- POST** `/api/plates/{plate_id}` Update Plate Details
- DELETE** `/api/plates/{plate_id}` Delete Plate Details
- GET** `/api/vehicles/{vehicle_id}` Get Vehicle Details
- POST** `/api/vehicles/{vehicle_id}` Update Vehicle Details
- DELETE** `/api/vehicles/{vehicle_id}` Delete Vehicle Details

**statistics**

- GET** `/api/statistics/dashboard` Get Statistics Dashboard
- GET** `/api/statistics/vehicle-distribution` Get Vehicle Distribution
- GET** `/api/statistics/detection-trend` Get Detection Trend
- GET** `/api/statistics/weekly-activity` Get Weekly Activity
- GET** `/api/statistics/plate-types` Get Plate Types
- GET** `/api/statistics/regions` Get Regions
- GET** `/api/statistics/status` Get Status Status

**locations**

- GET** `/api/locations/` Get All Locations
- POST** `/api/locations/` Create Location
- GET** `/api/locations/{location_id}` Get Location
- PUT** `/api/locations/{location_id}` Update Location
- DELETE** `/api/locations/{location_id}` Delete Location
- GET** `/api/locations/types` Get Location Types
- GET** `/api/locations/count` Get Location Count

**Schemas**

- `Body_add_plate_status_api_plate_status_post`
- `Body_detect_image_detect_image_post`
- `HTTPValidationError`
- `Location`
- `LocationBase`
- `LocationCreate`
- `SessionUpdate`
- `ValidationError`

The Swagger UI is accessible at <http://localhost:8000/docs> after starting the server.

For the latest endpoints and schemas, always refer to the live Swagger docs.

## Folder Structure

```
backend-api-endpoint/
├── app.py                # Main FastAPI application and entry point
├── endpoints/           # Modular API endpoint definitions
│   ├── detect_image.py
│   ├── latest_detection.py
│   ├── detections.py
│   ├── plate_regions.py
│   ├── plate_queries.py
│   ├── vehicle_queries.py
│   ├── statistics.py
│   ├── plate_status.py
│   ├── session_queries.py
│   └── location_routes.py
├── PlateDetector.py     # AI/ML logic for plate and vehicle detection
├── database.py          # Database connection and ORM logic
├── requirements.txt     # Python dependencies
├── outputs/            # Output images, crops, and detection artifacts
├── uploads/            # Temporary storage for uploaded images
├── static/             # Static files served by FastAPI
├── .env               # Environment variables
└── README.md          # This documentation
```

## API Overview

### Key Endpoints

#### Detection & Image Processing

Method	Endpoint	Description
POST	/detect/image	Upload an image for vehicle/plate detection
GET	/api/detection/latest	Fetch the most recent detection result
GET	/detections	List all detection events

Method	Endpoint	Description
GET	/outputs/{path}	Download detection result artifacts

## Vehicle Management

Method	Endpoint	Description
GET	/api/vehicles/{vehicle_id}	Get vehicle details by ID
PUT	/api/vehicles/{vehicle_id}	Update vehicle details
DELETE	/api/vehicles/{vehicle_id}	Delete a vehicle and related plates

## Plate Management

Method	Endpoint	Description
GET	/api/plates/{plate_id}	Get plate details by ID
PATCH	/api/plates/{plate_id}	Update plate details
DELETE	/api/plates/{plate_id}	Delete a plate and cascade if needed
GET	/api/plate/regions	Get all plate region mappings
GET	/api/plate/region/{code}	Get region name for a code

## Plate Status (Whitelist/Blacklist)

Method	Endpoint	Description
GET	/api/plate-status	List all plate statuses
POST	/api/plate-status	Add plate to whitelist/blacklist
DELETE	/api/plate-status/{plate_text}	Remove plate from status list
POST	/api/plate-status/sync-all	Sync all plate statuses

## Statistics & Analytics

Method	Endpoint	Description
GET	/api/statistics/dashboard	Get dashboard statistics
GET	/api/statistics/vehicle-distribution	Vehicle distribution data
GET	/api/statistics/detection-trend	Detection trend data
GET	/api/statistics/hourly-activity	Hourly activity data
GET	/api/statistics/plate-types	Plate type distribution
GET	/api/statistics/regions	Plate region distribution
GET	/api/statistics/status	API/database health

## Location Management

Method	Endpoint	Description
GET	/api/locations/	List all locations
POST	/api/locations/	Create a new location
PUT	/api/locations/{location_id}	Update a location
DELETE	/api/locations/{location_id}	Delete a location

## Static & Utility

Method	Endpoint	Description
GET	/static/{path}	Download static files
GET	/	API root/health check

## Example Inputs & Outputs

**POST** /detect/image

**Input:**

Form-data:

- file : (image file, required)



- `location` : (string, optional)

### Example Request (curl):

```
curl -F "file=@car.jpg" -F "location=Gate 1" http://localhost:8000/detect/image
```

### Example Output:

```
{
  "timestamp": "2025-06-07_12-34-56",
  "processing_time": 1.234,
  "stored_original_path": "outputs/uploaded/2025-06-07_12-34-56_uploaded-image.jpg",
  "detected_vehicle_image_path": "outputs/vehicles/2025-06-07_12-34-56_vehicle.jpg",
  "detected_plate_image_path": "outputs/plates/2025-06-07_12-34-56_plate.jpg",
  "image_resolution": "1920x1080",
  "session_id": 42,
  "location": "Gate 1",
  "list_vehicle_and_plate_information": [
    {
      "vehicle": {
        "vehicle_class": "car",
        "vehicle_confidence_score": 0.98,
        "vehicle_image_path": "outputs/vehicles/crops/abc123.jpg"
      },
      "plate": {
        "plate_text": "B123ABC",
        "ocr_confidence": 0.97,
        "plate_image_path": "outputs/plates/crops/xyz456.jpg"
      }
    }
  ]
}
```

### GET `/api/detection/latest`

#### Output:

```
[
  {
    "id": "42_v1_p1",
    "entity_type": "vehicle_with_plate",
    "vehicle_index": 1,
  }
]
```

```
    "plate_index": 1,
    "plateNumber": "B123ABC",
    "confidence": 0.97,
    "plateType": "Regular",
    "plateStatus": "whitelist",
    "vehicleType": "car",
    "vehicleConfidence": 0.98,
    "detectedTime": "2025-06-07 12:34:56",
    "gateLocation": "Gate 1 (Entry)",
    "originalImage": "/outputs/uploaded/2025-06-07_12-34-56_uploaded-image.jpg",
    "plateImage": "/outputs/plates/crops/xyz456.jpg",
    "processingTime": "1.234s",
    "imageResolution": "1920x1080",
    "plateTextColor": "Black",
    "plateBackgroundColor": "White",
    "plateRegion": "B (Jakarta)",
    "algorithm": "YOLOv11"
  }
]
```

## GET /detections

### Query Parameters:

- `limit` (int, default 100)
- `offset` (int, default 0)
- `vehicleType` (string, optional)
- `plateType` (string, optional)
- `search` (string, optional)

### Output:

```
{
  "detections": [
    {
      "id": 123,
      "detection_type": "plate",
      "timestamp": "2025-06-07 12:34:56",
      "original_path": "/outputs/uploaded/2025-06-07_12-34-56_uploaded-image.jpg",
      "file_path": "/outputs/plates/crops/xyz456.jpg",
      "annotated_path": "/outputs/plates/2025-06-07_12-34-56_plate.jpg",
      "processing_time": "1.23ms",
      "image_resolution": "1920x1080",
      "detection_details": {
        "vehicle_type": "car",
```

```
    "vehicle_confidence": 0.98,  
    "plate_text": "B123ABC",  
    "ocr_confidence": 0.97,  
    "confidence": 0.97,  
    "region": "B (Jakarta)",  
    "plate_status": "whitelist"  
  }  
}  
],  
"count": 1  
}
```

---

**GET** /api/vehicles/{vehicle\_id}

**Output:**

```
{  
  "id": 1,  
  "vehicle_class": "car",  
  "vehicle_confidence_score": 0.98,  
  "vehicle_image_path": "outputs/vehicles/crops/abc123.jpg",  
  "vehicle_bounding_box": [100, 200, 300, 400],  
  "timestamp": "2025-06-07 12:34:56",  
  "plates": [  
    {  
      "id": 10,  
      "plate_text": "B123ABC",  
      "plate_bounding_box": [120, 220, 180, 260]  
    }  
  ]  
}
```

---

**PUT** /api/vehicles/{vehicle\_id}

**Input:**

```
{  
  "vehicle_class": "truck",  
  "vehicle_confidence_score": 0.95  
}
```

**Output:**

```
{
  "message": "Successfully updated vehicle 1",
  "vehicle": {
    "id": 1,
    "vehicle_class": "truck",
    "vehicle_confidence_score": 0.95,
    ...
  }
}
```

---

**DELETE** `/api/vehicles/{vehicle_id}`

**Output:**

```
{
  "message": "Successfully deleted vehicle 1 with 1 plate records",
  "vehicle_deleted": true,
  "plates_deleted": 1,
  "session_deleted": false
}
```

---

**GET** `/api/plates/{plate_id}`

**Output:**

```
{
  "id": 10,
  "plate_text": "B123ABC",
  "plate_bounding_box": [120, 220, 180, 260],
  "plate_type": "Regular",
  "plate_status": "whitelist",
  "plate_region": "B (Jakarta)",
  "vehicle_class": "car",
  "timestamp": "2025-06-07 12:34:56"
}
```

---

**PATCH** `/api/plates/{plate_id}`

**Input:**

```
{
  "plate_text": "B456XYZ",
  "plate_status": "blacklist"
}
```

### Output:

```
{
  "message": "Successfully updated plate 10",
  "plate": {
    "id": 10,
    "plate_text": "B456XYZ",
    "plate_status": "blacklist",
    ...
  }
}
```

---

## DELETE /api/plates/{plate\_id}

### Output:

```
{
  "message": "Successfully deleted plate 10 and its associated vehicle",
  "plate_deleted": true,
  "vehicle_deleted": true,
  "session_deleted": false
}
```

---

## GET /api/plate/regions

### Output:

```
{
  "regions": [
    {"code": "B", "name": "Jakarta"},
    {"code": "D", "name": "Bandung"}
  ]
}
```

---

**GET** /api/plate/region/{code}

**Output:**

```
{
  "code": "B",
  "name": "Jakarta"
}
```

---

**GET** /api/statistics/dashboard

**Output:**

```
{
  "totalDetections": 1234,
  "vehicleDistribution": {"car": 900, "truck": 200, "motorcycle": 134},
  "detectionTrend": [
    {"date": "2025-06-01", "count": 100},
    {"date": "2025-06-02", "count": 120}
  ],
  "hourlyActivity": [
    {"hour": "08:00", "count": 50},
    {"hour": "09:00", "count": 70}
  ]
}
```

---

**GET** /api/statistics/status

**Output:**

```
{
  "status": "online",
  "timestamp": "2025-06-07T12:34:56.789123",
  "database": {
    "accessible": true,
    "path": "detections.db",
    "available_methods": ["get_statistics_dashboard_data", ...],
    "missing_methods": []
  },
  "router": {
    "prefix": "/api/statistics",
    "tags": ["statistics"],
  }
}
```

```
    "routes": [  
      {"path": "/api/statistics/dashboard", "methods": ["GET"]},  
      ...  
    ]  
  }  
}
```

---

## GET /api/plate-status

Output:

```
{  
  "status": "success",  
  "plate_statuses": [  
    {"plate_text": "B123ABC", "status": "whitelist"},  
    {"plate_text": "D456XYZ", "status": "blacklist"}  
  ]  
}
```

---

## POST /api/plate-status

Input:

```
{  
  "plate_text": "B123ABC",  
  "status_type": "whitelist"  
}
```

Output:

```
{  
  "status": "success",  
  "message": "Plate B123ABC added to whitelist"  
}
```

---

## DELETE /api/plate-status/{plate\_text}

Output:

```
{
  "status": "success",
  "message": "Plate B123ABC removed from status list"
}
```

---

**POST** /api/plate-status/sync-all

**Output:**

```
{
  "status": "success",
  "message": "Successfully synchronized 100 plate statuses",
  "details": {
    "whitelist": 60,
    "blacklist": 30,
    "unclassified": 10
  }
}
```

---

**GET** /api/locations/

**Output:**

```
[
  {"id": 1, "name": "Gate 1", "type": "Entry", "timestamp": "2025-06-07 12:00:00"},
  {"id": 2, "name": "Gate 2", "type": "Exit", "timestamp": "2025-06-07 12:10:00"}
]
```



---

**POST** /api/locations/

**Input:**

```
{
  "name": "Gate 3",
  "type": "Entry"
}
```

**Output:**



```
{
  "id": 3,
  "name": "Gate 3",
  "type": "Entry",
  "timestamp": "2025-06-07 13:00:00"
}
```

---

**PUT** /api/locations/{location\_id}

**Input:**

```
{
  "name": "Gate 1A",
  "type": "Entry"
}
```

**Output:**

```
{
  "id": 1,
  "name": "Gate 1A",
  "type": "Entry",
  "timestamp": "2025-06-07 12:00:00"
}
```

---

**DELETE** /api/locations/{location\_id}

**Output:**

```
{
  "message": "Location 1 deleted successfully"
}
```

---

**GET** /outputs/{path}

**Output:**

Returns the requested file as a download (image or artifact).

If not found, returns:

```
{  
  "detail": "File not found: {path}"  
}
```

---

**GET** /static/{path}

**Output:**

Returns the requested static file.

---

*For more endpoints and details, see the live Swagger UI at <http://localhost:8000/docs>.*



## License

This backend system is developed and maintained by **@GalaxyDeveloper**.



## Citation

If you use **Galaxy ALPR REST API** in your research, academic paper, or production system, please cite:

```
Galaxy ALPR Backend - Modular Backend for AI-Powered License Plate Recognition  
Developed by @GalaxyDeveloper (2025)  
Includes FastAPI, YOLOv11n, OCR, and SQLite Integration
```



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**Galaxy ALPR REST API** – Modular, scalable backend for intelligent vehicle and plate detection. *Powered by FastAPI, YOLOv11n, OCR, and SQLite*

**Developed by @GalaxyDeveloper — 2025**

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