Galaxy ALPR App – Database

This folder manages the relational database for the Galaxy ALPR (Automatic License Plate Recognition) App. It provides persistent storage for vehicle detections, license plates, session logs, and location metadata.

Project Purpose

The database is designed to:

- Store all vehicle and license plate detections from the ALPR pipeline.
- Track detection sessions, including images, processing times, and locations.
- Maintain metadata for each vehicle and plate, including region, type, and status (whitelist/blacklist).
- Support analytics, dashboard statistics, and API queries for the backend.

Tech Stack

- **Database:** SQLite (default, file-based, easy for local/dev; can be swapped for PostgreSQL or others)
- **ORM/Access:** Python `sqlite3` module (see `database.py`)
- **Schema Management:** Programmatic migrations in `database.py` (no external migration tool required)
- **Directory:** All schema and DB logic is in the `database/` folder

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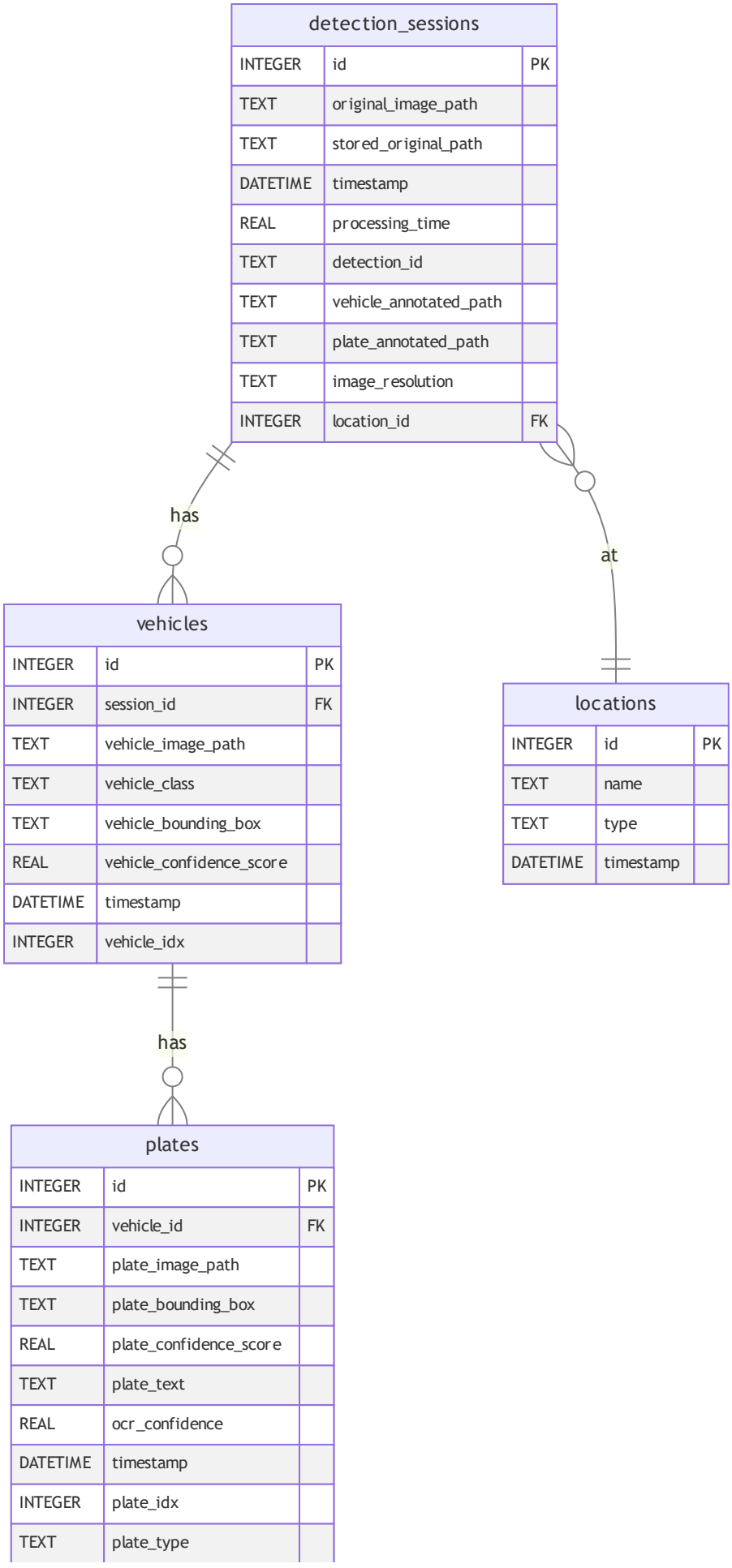
detection_sessions
INTEGER id PK
TEXT original_image_path
TEXT stored_original_path
DATETIME timestamp
REAL processing_time
TEXT detection_id
TEXT vehicle_annotated_path
TEXT plate_annotated_path
TEXT image_resolution
INTEGER location_id FK
has
at
vehicles
INTEGER id PK
INTEGER session_id FK
TEXT vehicle_image_path
TEXT vehicle_class
TEXT vehicle_bounding_box
REAL vehicle_confidence_score
DATETIME timestamp
INTEGER vehicle_idx
locations
INTEGER id PK
TEXT name
TEXT type
DATETIME timestamp
has
plates
INTEGER id PK
INTEGER vehicle_id FK
TEXT plate_image_path
TEXT plate_bounding_box
REAL plate_confidence_score
TEXT plate_text
REAL ocr_confidence
DATETIME timestamp
INTEGER plate_idx
TEXT plate_type

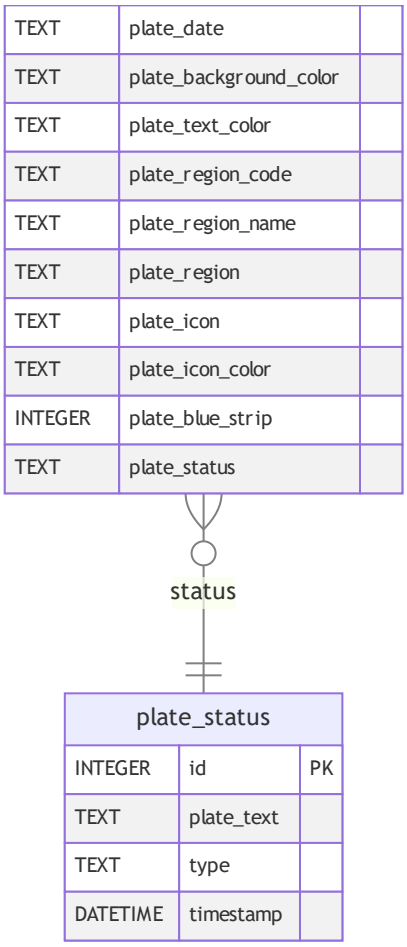

Figure: Entity-Relationship (ER) Diagram

Schema Outline

detection_sessions

- `id` (PK): Unique session ID
- `original_image_path`: Path to uploaded image
- `stored_original_path`: Path to stored copy in outputs
- `timestamp`: Detection time (WITA/GMT+8)
- `processing_time`: Time taken for detection (seconds)
- `detection_id`: Unique string for session
- `vehicle_annotated_path`: Path to annotated vehicle image
- `plate_annotated_path`: Path to annotated plate image
- `image_resolution`: e.g. "1920x1080"
- `location_id` (FK): Reference to `locations.id`

vehicles

- `id` (PK): Unique vehicle ID
- `session_id` (FK): Reference to `detection_sessions.id`
- `vehicle_image_path` : Path to cropped vehicle image
- `vehicle_class` : e.g. "car", "motorcycle"
- `vehicle_bounding_box` : JSON array [x1, y1, x2, y2]
- `vehicle_confidence_score` : Detection confidence (float)
- `timestamp` : Detection time
- `vehicle_idx` : Index within session

plates

- `id` (PK): Unique plate ID
- `vehicle_id` (FK): Reference to `vehicles.id`
- `plate_image_path` : Path to cropped plate image
- `plate_bounding_box` : JSON array [x1, y1, x2, y2]
- `plate_confidence_score` : Detection confidence (float)
- `plate_text` : OCR result
- `ocr_confidence` : OCR confidence (float)
- `timestamp` : Detection time
- `plate_idx` : Index within vehicle
- `plate_type` : e.g. "Regular", "Government"
- `plate_date` : Registration/expiry date (if available)
- `plate_background_color` : e.g. "White", "Yellow"
- `plate_text_color` : e.g. "Black"
- `plate_region_code` : e.g. "B"
- `plate_region_name` : e.g. "Jakarta"
- `plate_region` : Combined display (e.g. "B (Jakarta)")
- `plate_icon` : Icon on plate (if any)
- `plate_icon_color` : Color of icon
- `plate_blue_strip` : 1 if present, else 0
- `plate_status` : "whitelist", "blacklist", or "unclassified"

locations

- `id` (PK): Unique location ID
- `name` : e.g. "Gate 1"

- `type` : "Entry" or "Exit"
- `timestamp` : Creation time

plate_status

- `id` (PK): Unique status ID
- `plate_text` (UQ): Plate text (unique)
- `type` : "whitelist" or "blacklist"
- `timestamp` : Last update

Table Descriptions

- **detection_sessions**: Each detection event; links to original and processed images, processing time, and location.
- **vehicles**: Each detected vehicle in a session; stores class, image, and bounding box.
- **plates**: Each detected license plate; stores cropped image, OCR text, confidence, and rich metadata (type, region, color, etc.).
- **locations**: Named entry/exit points; referenced by sessions.
- **plate_status**: Tracks whitelist/blacklist status for plate texts.

Example Data Flow

1. **Image Upload:** User uploads an image via API.
2. **Detection:** Pipeline detects vehicles and plates, saves crops and metadata.
3. **Session Insert:** New row in `detection_sessions` with image paths, time, location.
4. **Vehicle Insert:** Each detected vehicle is added to `vehicles` (linked to session).
5. **Plate Insert:** Each detected plate is added to `plates` (linked to vehicle), with all OCR and region metadata.
6. **Status Update:** If a plate is whitelisted/blacklisted, `plate_status` is updated and all matching plates are marked.

Database Setup Instructions

1. **Install Python 3.8+** (if not already installed)

2. **No external DB install needed** (uses SQLite by default)
3. **First run:** The schema is auto-created by `database.py` when the backend starts.

Manual DB Management

- The SQLite file is created at `backend/detections.db` (or as configured).
- Use any SQLite browser (e.g., DB Browser for SQLite) for inspection.

SQL Scripts / Migration

- **No separate migration scripts**: All schema creation is handled in `Database.init_db()` in `database.py`.
- To reset the DB, delete the `.db` file and restart the backend.

Usage in API Backend

- All database access is via the `Database` class in `database.py`.
- The backend uses this class for all CRUD operations, statistics, and dashboard queries.
- See `database.py` for method documentation and usage.

How the DB is Used by the API

- **Detection Endpoints:** Insert sessions, vehicles, and plates on each detection.
- **Query Endpoints:** Fetch sessions, vehicles, plates, and statistics for dashboards.
- **Plate Status Endpoints:** Manage whitelist/blacklist and synchronize plate statuses.
- **Location Endpoints:** Manage entry/exit locations for detections.

Local Development

- **Local:** No setup required; DB file is created on first run.
- **Config:** Change the DB path by passing a different `db_path` to the `Database` class.

📄 License

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

📌 Citation

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

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

Developed by @GalaxyDeveloper — 2025
