

Project Report: Vehicle Parking App - V1

Author

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I am a dual-degree student and this is my first full-stack Flask project. I enjoyed learning backend development and database integration through it

Description

The objective of the project is to develop a multi-user vehicle parking management app. The app allows admins to manage parking lots and users to book/release parking spots. The focus is on time-stamped booking and charge calculation.

Technologies Used

- Python 3.10
- Flask (backend)
- Jinja2 (templating)
- SQLite (database)
- HTML/CSS/Bootstrap (frontend)
- JavaScript + Chart.js (for charts)
- Flask extensions: Flask-SQLAlchemy, Flask-Login, Flask-WTF

Purpose: These were chosen to simplify app development using Python and support modular development with templates and database models.

DB Schema Design

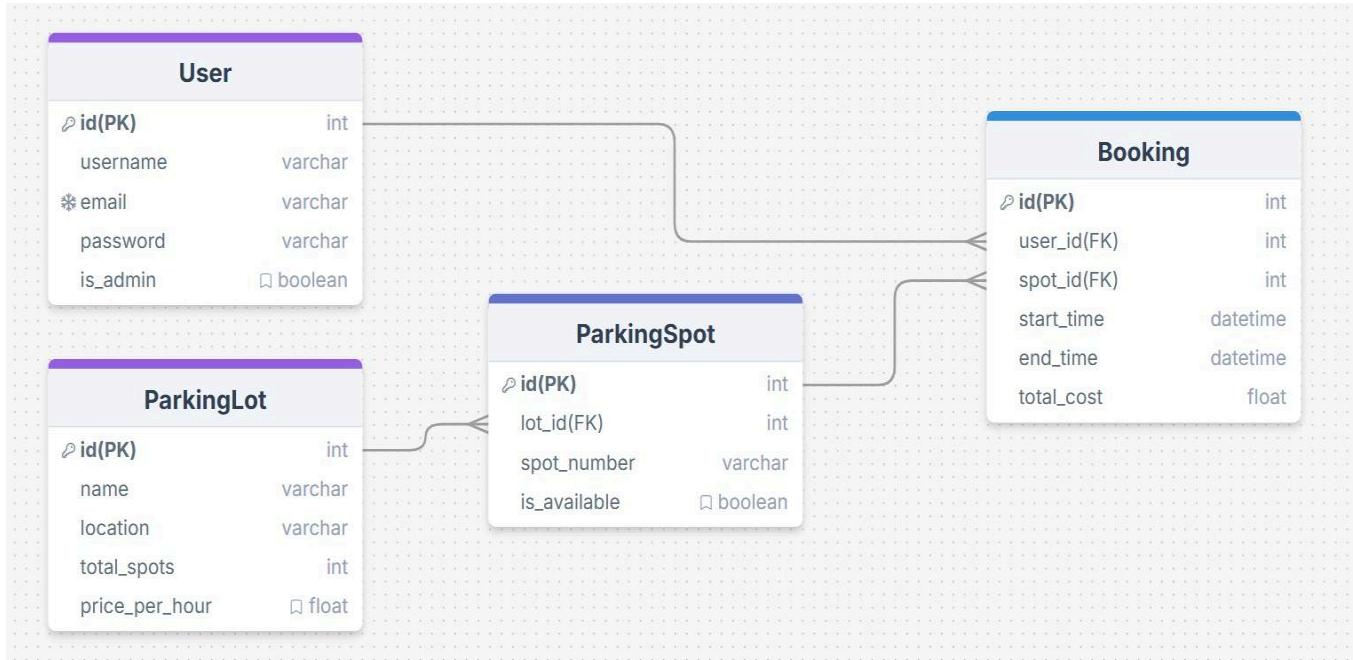
Our database consists of four main entities: User, ParkingLot, ParkingSpot, and Booking.

- **User** table stores authentication details. **email** is unique, and **is_admin** identifies admin access.
- **ParkingLot** represents each parking area with attributes like **location**, **total_spots**, and **price_per_hour**.
- **ParkingSpot** is linked to a ParkingLot via **lot_id (FK)**, with each spot having a **spot_number** and **is_available** flag.
- **Booking** logs user parking activity, linking users and spots with **start_time**, **end_time**, and **total_cost**.

All tables use an **id** as the primary key. Foreign keys ensure referential integrity across tables.

Design Rationale:

- Separation of User and Booking allows tracking multiple bookings per user.
- Splitting ParkingLot and ParkingSpot allows flexible management of spots within lots.
- Storing start_time and end_time in Booking enables precise cost calculation and parking duration analysis.



API Design

This project does not use full REST APIs. However, a minimal internal JSON API endpoint (/charts/data) was implemented to dynamically fetch chart data for admin and user dashboards using Chart.js. Data exchange was handled using `fetch()` in JavaScript, with backend response via Flask's `jsonify()`.

Architecture and Features

Project Architecture

The Vehicle Parking App – V1 uses a modular architecture built on the Flask web framework. The core logic resides in the app/ directory with clear separation of concerns.

- **Controllers (Routes):** Found in app/routes/ as admin.py, user.py, and auth.py.
 - admin.py handles admin tasks like lot creation, user management, and charts.
 - user.py manages user features such as booking, releasing, and viewing history.
 - auth.py handles authentication, including login, logout, and role redirection.
- **Models:** Defined in app/models.py using SQLAlchemy, covering Users, Parking Lots, Spots, and Booking with proper relationships.
- **Templates (Frontend):** Located in app/templates/, organized into admin/ and user/ folders. Shared layout via base.html uses Bootstrap and Jinja2.
- **Static Files:** CSS and JavaScript (e.g., Chart.js) are stored in static/.
- **Database Setup:** create_db.py initializes the database schema.
- **App Entry:** app.py starts the app; __init__.py configures and registers routes.

Implemented Features

Core Features:

- **User Registration & Login:** Includes validation and password hashing. Role-based redirection sends users/admins to their respective dashboards.
- **Admin Authentication:** Predefined admin (no registration) secured via `@admin_required` decorator.
- **Parking Lot Management (Admin):** Admins can create, edit, delete lots. Spots auto-generated based on lot capacity.
- **User Management (Admin):** View all registered users, their bookings, and spot details.
- **Spot Status View:** Admin can see real-time availability of spots per lot.

User Features:

- **Book/Release Spot:** Users can book available spots and release them. Cost is calculated using timestamps and shown before confirmation.
- **Booking History:** Users can view active and past reservations.
- **Charts (User):** Visualizes user activity – active vs. released spots and past booking costs.

Admin Analytics:

- **Charts (Admin):** Bar chart showing bookings per lot.
- **Earnings Summary:** Displays total earnings from all released sessions.

Additional Features:

Includes role-based access, validations, auto spot generation, earnings tracker, and dynamic charts via Chart.js.

Video

<https://drive.google.com/file/d/1r22N1YAdOIJnGaA0n-cffrwAY15zefRw/view?usp=sharing>