



IndDN Maps

Full-Stack Interactive Mapping Platform for India

Laravel 12

Leaflet.js 1.9.4

MySQL 8

OpenStreetMap

OSRM Routing

PWA

Multi-stop Routes

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MapApp — Project Documentation

Version: 1.3.0 | **Date:** May 2026 | **Stack:** Laravel 12 + Leaflet.js

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1. Executive Summary

MapApp is a full-featured, browser-based mapping platform built on open-source technologies. It replicates and extends the core capabilities of commercial mapping products (Google Maps, Apple Maps) while running entirely on self-hosted infrastructure — with no per-request licensing fees for core mapping functionality.

What it delivers for users

Capability	Description
Interactive map	Pan, zoom, switch between road, satellite, terrain, hybrid, Moon, and Mars views
Place search	Instant autocomplete search powered by OpenStreetMap data
Routing	Door-to-door directions by car, foot, or bicycle with alternate route options
Nearby discovery	Find restaurants, hospitals, ATMs, fuel stations, and 8 other categories within a chosen radius
Personal places	Save, tag, and revisit favourite locations; export your data at any time
Drawing tools	Sketch lines, polygons, and rectangles directly on the map with live distance/area measurements
GPX/KML import	Upload GPS tracks from hiking, cycling, or fitness apps and visualise them on the map
Traffic data	Real-time colour-coded traffic flow and incident tiles along a route
Elevation profile	Terrain elevation chart with ascent/descent stats after every route calculation
Street View	Embedded Google Maps Street View for any location
Sharing	One-click shareable URLs that encode the exact map view

What makes it investable

- **Zero tile-licensing cost** — map tiles sourced from OpenStreetMap (free), ESRI (free tier), and OpenTopoMap (free)
- **No routing API fees** — directions powered by the OSRM public demo server (self-hostable for production)
- **Monetisation-ready** — user accounts, saved-places database, and search history are already in place; subscription tiers or API access can be layered on top
- **Extensible** — clean Laravel backend makes adding premium features (custom tile servers, analytics, team workspaces) straightforward

2. Technology Stack

Backend

Layer	Technology	Version	Purpose
Framework	Laravel	12.x	MVC framework, routing, middleware, Eloquent ORM
Language	PHP	8.3	Server-side logic
Database	MySQL	8.x	User data, saved places, search history, sessions, cache
Authentication	Laravel Breeze	—	Registration, login, profile, password reset
HTTP Client	Laravel Http (Guzzle)	—	Proxy calls to Nominatim, OSRM, Overpass, TomTom
Cache	Laravel Cache (DB driver)	—	Response caching for all external API calls
Queue	Laravel Queue (DB driver)	—	Async job infrastructure (ready for background tasks)
Session	DB-backed sessions	—	Persistent sessions across requests

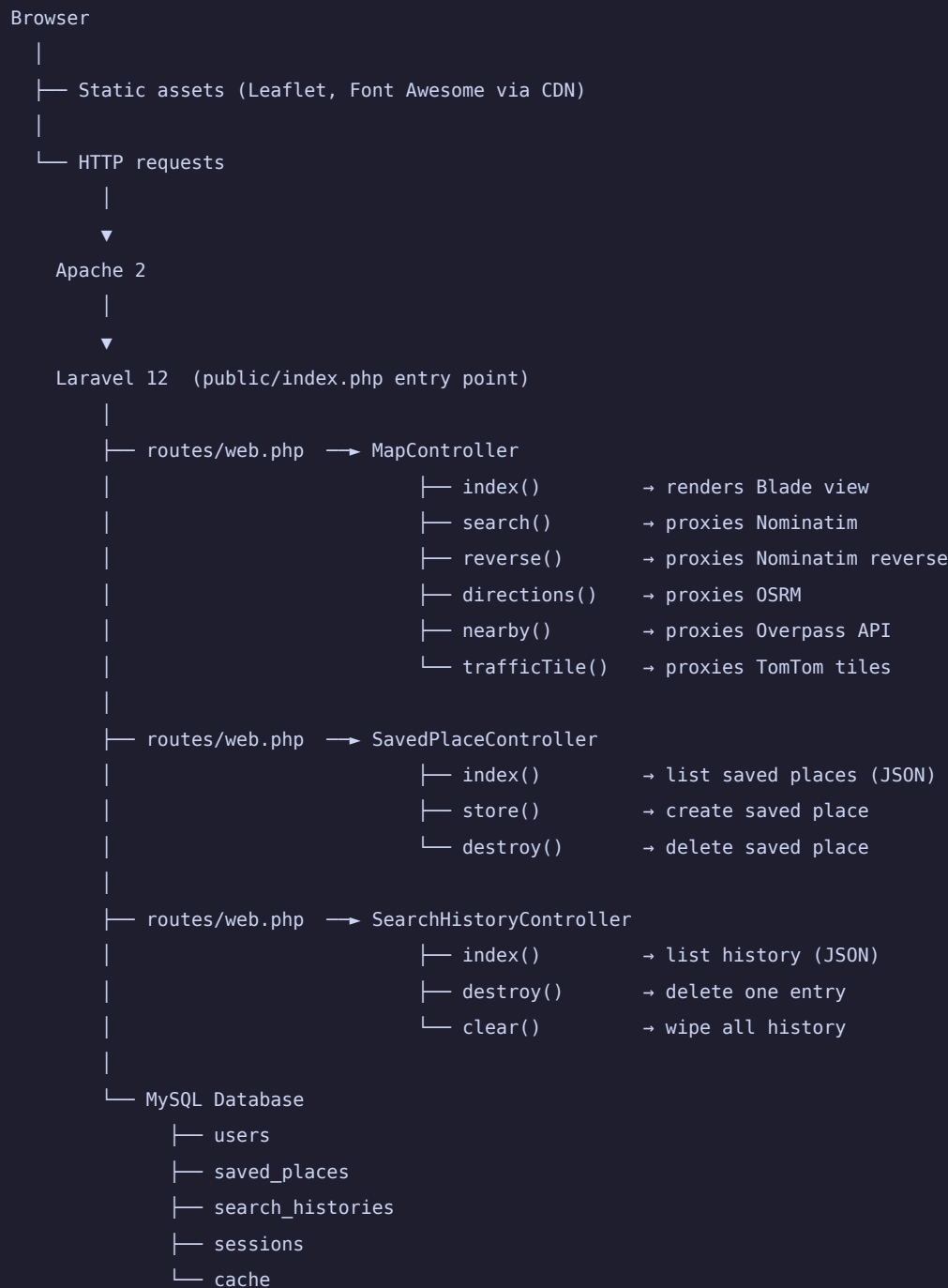
Frontend

Layer	Technology	Version	Purpose
Map engine	Leaflet.js	1.9.4	Interactive map rendering, layers, markers, polylines
Clustering	Leaflet.markercluster	1.5.3	Cluster nearby pins at low zoom levels
Heatmap	leaflet.heat	latest	Density heatmap of saved places
Icons	Font Awesome	6.5.0	All UI icons
Templating	Laravel Blade	—	Server-rendered HTML with dynamic data injection
Styling	Custom CSS	—	No framework dependency — fully bespoke UI

Infrastructure

Component	Choice
Web server	Apache 2 (mod_rewrite)
OS	Ubuntu 22.04 LTS
PHP process	PHP-FPM

3. Architecture Overview



Request flow for map search

```

User types "Mumbai" in search bar
  → 300 ms debounce fires
  → Browser: GET /map/search?q=Mumbai
  → Laravel throttle middleware checks rate limit (60 req/min)
  → MapController::search() checks cache key
    | Cache HIT → returns cached JSON immediately
    | Cache MISS → calls Nominatim API → stores result (30 min TTL) → returns JSON
  → If user is logged in: SearchHistory::updateOrCreate() deduplicates the entry
  → Browser renders dropdown results
  
```

4. Feature Catalogue

4.1 Map & Navigation

Five base map styles switchable via thumbnail buttons at the bottom-left:

Style	Tile Source	Use Case
Road	OpenStreetMap	Default street map
Satellite	ESRI World Imagery	Aerial photography
Terrain	OpenTopoMap	Outdoor / hiking
Hybrid	ESRI + OSM labels	Satellite with road labels
Dark	CartoDB Dark Matter	Night / low-light

Controls:

- Zoom in / out (mouse wheel, pinch, buttons)
- Fullscreen toggle
- GPS locate-me with live accuracy ring and follow-me panning
- Right-click context menu: "What's here", Street View, Directions from/to here, Save place

4.2 Search & Autocomplete

- **Debounced input** — search fires 300 ms after the user stops typing (reduces API calls by ~70% vs. firing on every keystroke)
- **Loading spinner** shown in the dropdown during the debounce wait
- **Coordinate shortcut** — typing `28.6139, 77.2090` jumps directly to those coordinates without an API call
- **Result dropdown** — up to 5 Nominatim results with name and sub-location text
- **Search history** — all searches by logged-in users are stored and deduplicated; clicking a history entry flies to that location

Backend: Nominatim results cached for **30 minutes** per unique query.

4.3 Directions & Routing

- **Three travel modes:** Driving, Walking, Cycling
- **Multi-stop routing** — hit `+` to insert amber via-stops between A and B (up to 5 stops)
 - Each via-stop has its own autocomplete field and can be removed individually
 - Amber dot markers placed on the map for each via point
 - Turn-by-turn steps span all legs combined
 - Alternate routes disabled for multi-stop (OSRM limitation); enabled for direct A→B
- **Up to 3 alternate routes** for direct A→B drawn simultaneously
 - Active route: solid coloured polyline (blue/green/orange by mode)
 - Alternates: grey dashed polylines, clickable to switch
- **Route selector cards** show distance, estimated time, and a badge (Fastest / Shorter / +N min)
- **Driving time** adjusted with 1.35× multiplier for Indian road conditions; labelled "(without traffic)"

- **Turn-by-turn steps** collapsible list with step icons (turn-left, turn-right, roundabout, etc.)
- **Live turn-by-turn navigation panel** — blue banner at top of map shows current instruction, next street, distance remaining; Previous/Next step buttons
- **Elevation profile** — automatically loaded after every route (see §4.10)
- **Autocomplete** in all direction input fields using Nominatim; Enter key triggers route calculation
- **Friendly error messages** distinguish between: no route found, invalid coordinates, routing server timeout, and network failure

Backend: `MapController::directions()` accepts optional `via[][lat]` / `via[][lng]` array parameters. OSRM coordinate chain is built as `lng,lat;lng,lat;...`. Responses cached for **10 minutes** keyed by MD5 of full coordinate string. Timeout: 30 s.

4.4 Nearby Places

12 searchable categories:

Category	Data Source
Restaurant, Cafe, Hospital, Pharmacy	OpenStreetMap via Overpass API
ATM, Fuel, Hotel, Supermarket	OpenStreetMap via Overpass API
Bank, School, Parking, Police	OpenStreetMap via Overpass API

Radius options: 500 m, 1 km, 2 km (default), 5 km, 10 km


Result cards include: name, address, phone, opening hours, distance from map centre

Marker clustering — when many results are close together, Leaflet.markercluster groups them into a numbered cluster badge that expands on click. Clustering disabled at zoom level ≥ 16 so individual pins are always visible at street level.

Backend: Overpass responses cached for **10 minutes**.

4.5 Saved Places

For authenticated users only.

- Save any map location with a **name, address, category, and notes**
- **Categories:** General, Home, Work, Food & Drink, Hotel, Shopping, Health, Other
- **Saved Places panel** (collapsible sidebar) lists all saved places with category icons
- **"Show on map" layer** — FAB button () overlays all saved pins on the map simultaneously as a toggleable layer; refreshes automatically after save/delete
- **Export** saved places in two formats:
 - **GeoJSON** — standard geospatial format compatible with QGIS, Mapbox, any GIS tool
 - **CSV** — opens in Excel / Google Sheets (columns: Name, Address, Category, Notes, Latitude, Longitude)
- **Heatmap** — see §4.8

4.6 Draw on Map

A fully custom drawing tool with no external library dependency.

Shape types:

Tool	How to finish	Measurement shown
Line	Double-click	Total length in m or km
Polygon	Double-click to close	Area in m ² or km ²
Rectangle	Click two corner points	Area in m ² or km ²

Controls (toolbar at bottom of map):

- Undo last point (also bound to keyboard shortcut)
- Finish current shape
- Undo last completed shape
- Clear all drawings
- Live measurement label updates as cursor moves

Implementation details:

- Polygon area calculated with the Shoelace formula corrected for latitude (accounts for Earth's curvature)
- Double-click handling pops the extra phantom click Leaflet fires before the dblclick event
- Draw mode and Ruler mode are mutually exclusive (activating one deactivates the other)
- Esc key exits draw mode
- Completed shapes get permanent tooltip labels on the map

4.7 GPX / KML Import

Upload a GPS track file recorded by any device or app (Garmin, Strava, Komoot, etc.).

Supported formats: `.gpx`, `.kml`

What is displayed:

- Track segments as coloured polylines
- Waypoints as marker pins with names
- Map auto-fits to the full track extent

Stats panel (bottom-left card) shows:

- File name
- Total distance
- Number of track segments
- Number of waypoints

Implementation: Parsed entirely in the browser using the native `DOMParser` API — no server upload, no third-party library.

Handles both GPX 1.0 and 1.1 namespaces.

4.8 Heatmap Layer

Visualises the **density of saved places** as a colour-gradient heatmap overlay.

- Powered by **leaflet.heat** (lazy-loaded on first toggle — not included in the initial page bundle)
- Gradient: Blue (sparse) → Green → Yellow → Red (dense)
- Map auto-fits to the bounding box of all points
- Automatically refreshes when a place is saved or deleted
- Requires login; shows a friendly prompt for guests

4.9 Traffic Layer

Real-time traffic tiles from the **TomTom Traffic API**.

- **Flow layer** — colour-coded road segments (green = free flow, yellow = slow, orange = very slow, red = stationary)
- **Incident layer** — icons for accidents, road works, closures
- Tiles are clipped to the current route's bounding box to focus on the relevant area
- **Traffic legend** shown on-map while traffic is active
- **API key proxied server-side** — the TomTom key is never exposed in the browser's HTML source or network requests; the browser calls `/map/traffic/{type}/{z}/{x}/{y}` which Laravel proxies with the key appended server-side
- Users can also supply their own TomTom key via the UI (stored in `localStorage`) as a fallback

4.10 Elevation Profile

Shown automatically in the directions panel after every successful route calculation.

- Samples up to 40 evenly-spaced points from the route geometry
- Fetches elevation for each point from the **OpenTopoData SRTM90m** dataset
- Renders an **SVG area chart** (no canvas, no chart library) with a blue gradient fill
- Stats shown below the chart:
 - Total ascent (+m)
 - Total descent (−m)
 - Maximum elevation
 - Elevation range (min-max)
- Gracefully shows "Elevation data unavailable" if the API is unreachable
- Cleared automatically when the route is cleared

4.11 Planet Maps

Switch between Earth and two celestial bodies using the map-type selector.

Planet	Tile Source	Special behaviour
Moon	NASA / ESRI Moon Imagery	Dark navbar, "Moon Surface" badge, Earth-specific buttons hidden
Mars	NASA / USGS MOLA Colorized Elevation (OpenPlanetaryMap)	Rust-brown navbar, "Mars Surface" badge, Earth-specific buttons hidden

When on Moon or Mars:

- Directions, Nearby, and Traffic buttons are hidden (they require real-world geocoding)
- Street View popup button is hidden
- Right-click context menu is suppressed
- Map click does not place a location pin
- Broken-tile icon suppressed with a transparent error tile fallback

4.12 Street View

Embeds Google Maps Street View for any selected location.

- Opens as a slide-up panel at the bottom of the screen
- Available from the location popup ("Street View" button) and the right-click context menu
- "Open in Google Maps" link launches full Google Maps in a new tab
- Panel close button stops the iframe network request immediately
- Hidden on Moon/Mars maps

4.13 Share & Export

Shareable URLs encode the map state as query parameters:

```
https://yourdomain.com/Map/public?lat=28.613900&lng=77.209000&zoom=15&name=New+Delhi
```

- URL updates **automatically** in the browser address bar as the user pans or zooms (`history.replaceState`) — no page reload, bookmarkable at any moment
- Share panel allows: copy link, share via WhatsApp, native OS share sheet
- "Share current view" button always reflects the latest map position

Export (saved places):

- GeoJSON download
- CSV download

Print: `Ctrl+P` / Print button generates a print-optimised layout with a header showing coordinates, zoom level, location name, and timestamp.

4.14 Distance Ruler

- Click to add measurement points anywhere on the map
- Each segment shows its individual length as a tooltip
- Running total displayed in the ruler bar at the bottom
- Undo last point, or clear all points
- Esc key exits ruler mode
- Mutually exclusive with Draw mode

4.15 User Accounts

Feature	Detail
Registration	Name, email, password with confirmation
Login / Logout	Persistent session (120-minute lifetime, DB-backed)
Profile	Edit name, email, change password, delete account
Password hashing	bcrypt with cost factor 12
CSRF protection	All POST/DELETE requests protected
Auth gates	Saved places and search history endpoints require authentication

4.16 Dark Mode

- Toggled via the `☐` button in the navbar
- Preference persisted in `localStorage` — remembered across sessions
- Applies to: navbar, sidebar, directions panel, nearby panel, modals, search results, route cards, step list, tooltips, GPX panel, draw bar, ruler bar, share panel
- When Dark Mode is active and the map type is Road, the tile layer automatically switches to CartoDB Dark Matter tiles for a fully dark map

4.17 Progressive Web App (PWA) & Mobile

Installable (PWA)

- `public/manifest.json` declares app name "IndDN Maps", standalone display mode, blue theme colour (`#4285F4`), and an SVG icon
- Service worker (`public/sw.js`) registered on page load via `navigator.serviceWorker.register()`
- On Android Chrome and desktop Chrome, the browser shows an "Add to Home screen" / "Install" prompt automatically
- When installed, the app opens without browser chrome in a native-like window

Offline tile caching (Service Worker)

Cache	Strategy	Limit	TTL
<code>tiles-v1</code>	Cache-first with TTL check	500 tiles	7 days
<code>static-v1</code>	Cache-first indefinitely	Unbounded	URL-versioned

Cached tile hosts: `tile.openstreetmap.org`, `basemaps.cartocdn.com`, `server.arcgisonline.com`.

API calls (`/map/*`, `/saved-places`, `/search-history`, auth routes) are **never** intercepted — they always go to the network to preserve authentication.

Mobile responsive layout (≤ 480 px)

- Print, PDF, and Docs nav buttons hidden (not useful on mobile)
- Directions and Nearby panels become **bottom sheets** (slide up from screen bottom, 80 vh max height, rounded top corners)

- Nav actions area scrollable if remaining buttons overflow
- Minimum 44 px touch targets on FAB buttons and category grid buttons
- Momentum scrolling enabled inside panel bodies (`-webkit-overflow-scrolling: touch`)
- All desktop layout, drag behaviour, and functionality unchanged at > 480 px

5. External APIs & Services

Service	Purpose	Authentication	Rate limit handled	Caching
Nominatim (OpenStreetMap)	Geocoding (search + reverse)	<code>User-Agent</code> header required	60 req/min (Laravel throttle)	30 min per query
OSRM (Project-OSRM public)	Routing & directions	None	60 req/min (Laravel throttle)	10 min per route
Overpass API	Nearby POI search	None	60 req/min (Laravel throttle)	10 min per query
TomTom Traffic API	Traffic flow & incident tiles	API key (server-side only)	Tile-level (CDN cached)	5 min per tile
OpenTopoData	Elevation data (SRTM 90m)	None	Client-side (per route)	None (fresh per route)
OpenPlanetaryMap	Mars MOLA elevation tiles	None	Tile-level	Browser cache
ESRI World Imagery	Satellite / Moon tiles	None	Tile-level	Browser cache
CartoDB	Dark mode tiles	None	Tile-level	Browser cache
Google Maps embed	Street View iframe	None (embed URL)	N/A	N/A

6. Security Measures

Measure	Implementation
CSRF protection	<code>meta[name=csrf-token]</code> injected in every page; all state-changing requests include <code>X-CSRF-TOKEN</code> header
SQL injection	Eloquent ORM with parameterised queries throughout
XSS	Blade <code>{{ }}</code> escaping on all user-supplied output; JS string values escaped before insertion into innerHTML
API key exposure	TomTom key stored only in <code>.env</code> ; proxied server-side — never appears in HTML source, JS variables, or network requests to the browser
Authentication gates	<code>SavedPlaceController</code> and <code>SearchHistoryController</code> have <code>middleware('auth')</code> in constructor; policy checks (<code>\$this->authorize</code>) on delete
Rate limiting	<code>throttle:60,1</code> middleware on all map API routes — prevents abuse of Nominatim's 1 req/sec policy and OSRM/Overpass servers
Input validation	All controller methods use <code>\$request->validate()</code> with typed rules (numeric, between, max, in)
Mass assignment	Eloquent <code>\$fillable</code> arrays defined on all models
HTTPS-ready	<code>APP_URL</code> and asset URLs use the configured scheme; no hardcoded <code>http://</code> in tile URLs

7. Performance Optimisations

Optimisation	Detail
Server-side caching	All external API responses cached in MySQL using <code>Cache::remember()</code> . Search: 30 min. Directions: 10 min. Nearby: 10 min. Traffic tiles: 5 min.
Debounced search	300 ms debounce prevents a request on every keystroke; coordinate detection short-circuits before any network call
Lazy-loaded heatmap library	<code>leaflet.heat</code> (~14 KB) is not loaded on page open. It is injected into <code><head></code> dynamically the first time the user clicks the heatmap button
Marker clustering	Leaflet.markercluster groups hundreds of nearby markers into single cluster badges — prevents DOM overload and visual noise
DNS prefetch / preconnect	<code><link rel="dns-prefetch"></code> and <code><link rel="preconnect"></code> declared for all external tile and API hostnames — reduces TCP handshake time on first tile request
Transparent error tiles	Planet maps (Moon/Mars) use a 1×1 transparent GIF as <code>errorTileUrl</code> — suppresses broken-tile network-error icons for tiles that don't exist at high zoom
Search result caching	Cache key is <code>md5(strtolower(trim(\$query)))</code> — case-insensitive deduplication without key collisions
Route geometry simplification	OSRM called with <code>overview=simplified</code> — reduces polyline coordinate count for smoother rendering
Service Worker tile cache	Browser-side cache-first strategy for map tiles (500 tile limit, 7-day TTL). Repeat visits load cached tiles instantly with no network round-trip
CDN static asset cache	Leaflet, FontAwesome, and MarkerCluster loaded from CDN and cached indefinitely in <code>static-v1</code> cache — zero re-download on repeat visits

8. Database Schema

users

Column	Type	Notes
id	BIGINT PK	
name	VARCHAR(255)	
email	VARCHAR(255) UNIQUE	
password	VARCHAR(255)	bcrypt hashed
remember_token	VARCHAR(100)	
created_at / updated_at	TIMESTAMP	

saved_places

Column	Type	Notes
id	BIGINT PK	
user_id	BIGINT FK → users	
name	VARCHAR(255)	
address	VARCHAR(500) NULL	
latitude	DECIMAL(10,7)	
longitude	DECIMAL(10,7)	
category	VARCHAR(50) NULL	general, home, work, food, hotel, shopping, health, other
notes	TEXT NULL	
created_at / updated_at	TIMESTAMP	

search_histories

Column	Type	Notes
id	BIGINT PK	
user_id	BIGINT FK → users	
query	VARCHAR(255)	Unique per user — DB unique index on (user_id, query) prevents duplicates
latitude	DECIMAL(10,7) NULL	From top search result
longitude	DECIMAL(10,7) NULL	From top search result
display_name	TEXT NULL	Full formatted address
created_at / updated_at	TIMESTAMP	updated_at used to sort by most recent

sessions / cache / jobs

Standard Laravel scaffold tables (no custom columns).

9. Project File Structure

```
Map/
├── app/
│   ├── Http/
│   │   └── Controllers/
│   │       ├── MapController.php           ← Core map API endpoints
│   │       ├── SavedPlaceController.php   ← CRUD for saved places
│   │       ├── SearchHistoryController.php
│   │       ├── ProfileController.php      ← Breeze profile management
│   │       └── PdfController.php          ← Feature roadmap PDF export
│   ├── Models/
│   │   ├── User.php
│   │   ├── SavedPlace.php
│   │   └── SearchHistory.php
│   └── Policies/
│       ├── SavedPlacePolicy.php
│       └── SearchHistoryPolicy.php
├── resources/
│   └── views/
│       ├── map/
│       │   └── index.blade.php             ← Main application view (~4500 lines)
│       └── auth/                          ← Breeze login/register/profile views
├── routes/
│   ├── web.php                            ← All application routes + rate limiting
│   └── auth.php                          ← Breeze auth routes
├── database/
│   └── migrations/                        ← Table definitions
├── public/
│   ├── manifest.json                     ← PWA manifest (name, icon, theme colour)
│   ├── sw.js                             ← Service worker (tile + CDN caching)
│   ├── icons/
│   │   └── icon.svg                       ← App icon (192 × 192, blue map-pin)
│   └── data/
│       └── india-boundary.geojson         ← Simplified SoI boundary (55 KB)
├── .env                                  ← Environment config (API keys, DB creds)
└── PROJECT_DOCUMENTATION.md              ← This file
```

10. Deployment & Configuration

Environment variables (`.env`)

Key	Description
<code>APP_URL</code>	Public URL (e.g. <code>https://inddn.in/maps</code>) — used for asset URLs and HTTPS forcing
<code>TOMTOM_API_KEY</code>	TomTom Traffic API key — proxied server-side, never exposed to browser
<code>DB_HOST</code> / <code>DB_DATABASE</code> / <code>DB_USERNAME</code> / <code>DB_PASSWORD</code>	Main MySQL connection (<code>map_app</code> DB)
<code>PLATFORM_DB_HOST</code> / <code>PLATFORM_DB_DATABASE</code> / <code>PLATFORM_DB_USERNAME</code> / <code>PLATFORM_DB_PASSWORD</code>	Shared platform MySQL connection (<code>inddn_platform</code> DB — shared <code>users</code> table with <code>inddn.in</code>)
<code>SESSION_DOMAIN</code>	<code>.inddn.in</code> — allows session cookie to be shared across <code>inddn.in</code> and <code>inddn.in/maps</code>
<code>CACHE_STORE</code>	Set to <code>database</code> (default) or <code>redis</code> for production
<code>SESSION_DRIVER</code>	Set to <code>database</code>
<code>APP_ENV</code>	<code>local</code> for development, <code>production</code> for live
<code>APP_DEBUG</code>	<code>false</code> in production

Apache configuration

The app requires `mod_rewrite` enabled and an `.htaccess` or `VirtualHost` with:

```
<VirtualHost *:80>
  DocumentRoot /data/html/Map/public
  <Directory /data/html/Map/public>
    AllowOverride All
    Require all granted
  </Directory>
</VirtualHost>
```

First-time setup

```
composer install
cp .env.example .env
php artisan key:generate
php artisan migrate
php artisan storage:link
```

Production checklist

- Set `APP_ENV=production` and `APP_DEBUG=false`
- Set `APP_URL` to the HTTPS public URL
- Configure `TOMTOM_API_KEY`
- Configure `PLATFORM_DB_*` for shared user accounts
- Set `SESSION_DOMAIN=.inddn.in` for cross-path session sharing
- Switch `CACHE_STORE` to `redis` for multi-server deployments
- Set up a cron job for `php artisan schedule:run`

- Configure queue worker: `php artisan queue:work`
- Run `php artisan config:cache && php artisan route:cache && php artisan view:cache`
- Verify PWA: open DevTools → Application → Manifest and Service Workers

Standard deploy command

```
cd /var/www/maps
git pull origin main
php artisan migrate --force
php artisan config:cache
php artisan view:cache
```

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