



1. Project Overview

CampusCompass is a full-stack **Progressive Web Application (PWA)** designed to simplify navigation for students, staff, and visitors at the **NWU Potchefstroom Campus**. It provides interactive maps, real-time walking directions, a searchable building and lecturer directory, and offline access — all accessible via any modern browser or as an installable app.

2. System Features

2.1 Core User Features

■	Interactive Campus Map	Explore buildings and points of interest using Mapbox GL JS.
■	Turn-by-Turn Navigation	Step-by-step walking routes via Mapbox Directions API.
■	Real-Time Location Tracking	GPS-based live positioning and route updates.
■	Building & Office Directory	Search by building name or code (e.g., F1, Library).
■	Lecturer & Staff Search	Find lecturers by name or department and get directions to their offices.
■	Emergency Services Panel	One-tap access to campus security and medical services.
■	Offline Functionality	Cached assets ensure usability without internet access.
■	Install to Home Screen	Quick access from mobile or desktop.
■	Dark Mode	Enhanced readability in low-light environments.

2.2 Administrative Features

- Secure JWT-based authentication with refresh token rotation.



- Full CRUD operations for buildings, offices, and lecturer records.
- Role-based access control for authorized administrators.
- Swagger-documented REST API for easy integration.
- Seed scripts for bulk data import.

3. System Architecture

3.1 Overview

Layer	Technology	Role
Frontend	React.js + TypeScript	UI, map rendering, routing, PWA shell
API Gateway	Node.js + Express	Request routing, authentication
Backend Services	Node.js + Mongoose	Business logic, CRUD operations
Database	MongoDB Atlas	Persistent data storage
External Services	Mapbox APIs	Maps, geocoding, directions
Infrastructure	Docker + CI/CD	Containerized deployment

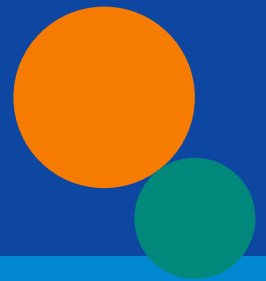
3.2 Data Flow

1	User opens the app Service Worker checks cache for offline assets.
2	Frontend requests data Backend API receives and processes the request.
3	API authenticates Queries MongoDB using validated credentials.
4	Data returned as JSON Results rendered visually on the interactive map.
5	Mapbox Directions API Provides walking routes and step-by-step instructions.

3.3 Authentication & Security

- Admins log in via /admin/login endpoint.
- Credentials validated against hashed MongoDB records.
- JWT tokens manage session security with refresh token rotation.





- Role-based middleware restricts unauthorized access.

3.4 PWA Offline Strategy

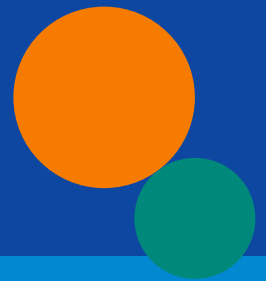
Strategy	Usage	Benefit
Cache-First	Static assets, map tiles	Fast loads from local cache
Network-First	API calls	Always fresh data when online
Fallback	Poor/no connectivity	Usable offline experience

4. Technology Stack

Category	Technology	Version/Notes
Frontend Framework	React.js + TypeScript	Component-based UI
Map Engine	Mapbox GL JS	Interactive vector maps
Backend Runtime	Node.js + Express	RESTful API server
ODM	Mongoose	MongoDB object modeling
Database	MongoDB Atlas	Cloud-hosted NoSQL
Authentication	JWT + bcrypt	Secure token-based auth
PWA Support	Service Workers	Offline caching strategy
DevOps	Docker + CI/CD	Containerized deployment
API Docs	Swagger / OpenAPI	Interactive documentation

5. Data Model

Location	GeoJSON coordinates and metadata.
Building	Linked to a location, identified by name/code.
Office	Rooms within buildings, with descriptions.
Lecturer	Staff details linked to offices.
Admin	Hashed credentials for backend access.
RefreshToken	Secure token rotation and revocation.



6. API Endpoints Overview

Method	Endpoint	Description	Auth
POST	/admin/login	Admin authentication	Public
GET	/api/buildings	List all buildings	Public
POST	/api/buildings	Create new building	Admin
PUT	/api/buildings/:id	Update building record	Admin
DELETE	/api/buildings/:id	Delete building	Admin
GET	/api/lecturers	List all lecturers	Public
POST	/api/lecturers	Add new lecturer	Admin
GET	/api/offices	List all offices	Public
POST	/api/token/refresh	Refresh JWT token	Public

7. Getting Started

Web Browser	PWA Installation
1. Open any modern browser (Chrome, Safari, Firefox, Edge). 2. Visit campuscompass.nwu.ac.za. 3. Grant location permission for navigation. 4. Use the search bar or map to explore.	1. Open the site on your mobile browser. 2. Tap Install or Add to Home Screen. 3. Launch the app — it works offline after initial load.

8. Project Links & Resources

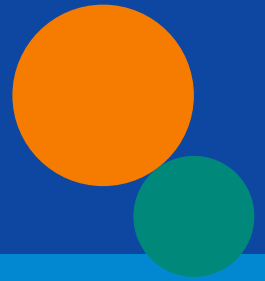
Web App	campuscompass.nwu.ac.za
API Documentation	Swagger UI at /api-docs
Source Repository	GitHub (internal repository)
API Base URL	/api/v1

9. Conclusion

CampusCompass

Smart Navigation for the NWU Potchefstroom Campus

System Summary Document



CampusCompass effectively addresses the navigation challenges at NWU Potchefstroom through a modern, offline-capable PWA. Its **modular architecture**, **secure authentication**, and **scalable design** make it a sustainable solution ready for expansion across other NWU campuses.